Journal of
ORAL SURGERY

A JOURNAL DEVOTED TO THE ART AND SCIENCE OF ORAL SURGERY

Published by the AMERICAN DENTAL ASSOCIATION
222 East Superior St., Chicago, Ill.

Vol. 1 JANUARY 1943 No. 1

RECOVERY OF BROKEN HYPODERMIC NEEDLES IN THE THROAT

EARLE H. THOMAS, M.D., D.D.S., LL.B., Chicago, Ill.

HYPODERMIC needles may be broken off deep in the tissues in any region where anesthetic injections are made, but the region in which breakage most frequently occurs, and where it causes the greatest concern to the dentist, is the throat, during the so-called mandibular injection.

CONTRIBUTING CONDITIONS

There are many conditions that may contribute to the risk of such an accident, among which are:

1. Lack of knowledge of the anatomy of this region. A large proportion of needles that I have removed from the throat have been inserted a considerable distance from the proper region of injection, too far above, too far below, at an improper angle or to too great a depth. A few were crosswise of the coronoid process and above the level of the sigmoid notch. Several were below the inferior border of the ramus. Many extended almost into the temporomandibular joint. Some extended past the posterior border of the ramus.

2. Use of a needle of defective manufacture. Every new needle should be tested before use.

3. Use of an ordinary steel needle that has been boiled several times and is, therefore, rusted on the inside. I recall removing one needle which had rusted inside to such an extent that there was almost nothing left but the polish. The needle barely showed in the roentgenogram. Since

51598

the advent of rustless steel needles, breakage from this cause has been reduced.

4. Use of a platinum needle without tests at intervals to determine whether it has become brittle. A platinum needle that has been flamed several times past the point of dull red heat becomes brittle, as does one that has been bent several times in the same region.

5. Failure to caution the patient in advance not to move when he feels something touch the throat. When a tooth is to be removed, the patient naturally expects to feel something done near the tooth, and it is no wonder that he becomes alarmed and suddenly moves his head when he feels a needle prick his throat. One should never mention the word needle. The most advisable procedure is to swab the region of injection, rather forcibly, with an antiseptic solution so that the patient knows that throat tissue is being touched. The assistant hands the syringe to the

Fig. 1.—A. X-ray technic for direct lateral view. B. Resulting roentgenogram.

operator from behind the patient's head so that he does not see it. Telling the patient not to move when his throat is touched, the operator immediately inserts the needle through the surface tissue only and deposits some anesthetic. From there on, he can keep injecting ahead of the needle, while slowly and carefully inserting it deeper, without any sensation to the patient, until the point is in the region where the bulk of the anesthetic is to be injected. A more refined technic, here as in most other injections, calls for inserting the needle past the desired region and then withdrawing it to less than the optimal depth before depositing the bulk of the anesthetic. This procedure makes a conduit, allowing much more effective absorption of the anesthetic.

6. Failure to hold the mandible firmly while making the injection. In making the right mandibular injection, I have the first two fingers of

the left hand on the external oblique line, and the thumb on the lower border of the mandible. In making the left injection, I have my left arm over the patient's head, my left thumb on the external oblique line and my fingers on the lower border of the mandible. If, with such a grip on the jaw, the patient is able to move the head, it will be but slowly and the hand that holds the syringe can readily follow the movement of the head, thus avoiding bending the needle.

7. Insertion of a needle to the hub. Any side pressure on a needle is distributed evenly throughout its whole length except at the point where it joins the hub. At this point, all the side pressure is concentrated in 1 or 2 mm.; therefore, this area is very vulnerable to needle breakage. A needle of sufficient length should always be used so that insertion into the tissues up to the hub is not necessary.

8. "Jabbing" of the needle deep into the tissues, resulting in unexpect-

Fig. 2.—A. X-ray technic for postero-anterior view. B. Resulting roentgenogram. C. Direct lateral view of B, showing guide needle and broken needle almost superimposed on same plane.

edly striking the ramus with the point of the needle. Striking bone while inserting a needle in this manner will cause the needle to buckle and break. Any quick thrust of the needle should be through the thickness of the mucous membrane only, as indicated in paragraph 5. In this regard, it should be noted that the proper depth of insertion of a needle may frequently vary from 5 to 35 mm. in different patients, and there are sometimes even greater variations. This variation in depth depends on the relation of the arch of the palate to the inferior dental foramen. In view of this fact, the folly of following some rule of "average depth to insert a needle" is immediately evident. The average depth has little relation to the depth indicated for the particular patient.

9. Insertion of a needle part way, followed by moving of the barrel of the

syringe to a different angle before insertion of the needle the rest of the way. The needle should be inserted in the shortest and most direct line to have its point reach the desired area.

10. Insertion of a needle to what one thinks is a proper depth without the point of the needle contacting bone, followed by an effort to make this contact by changing the angle of the barrel of the syringe. Instead, the needle should be withdrawn for almost its entire length and reinserted in the desired direction. Involvement in such a situation will be less common if a needle having a slight curve throughout its length is employed. That the inner surface of the ramus is seldom parallel with the sagittal plane, but flares outward, sometimes at an angle of 45 degrees, should always be kept in mind.

11. Failure to caution the patient to keep the mouth wide open during the injection. Each change of position of the mandible changes the relative positions of the muscles and ligaments of the throat through which the needle is inserted.

Fig. 3.—Left: Direct lateral view of another case plus postero-anterior view. Right: Direct lateral view plus two postero-anterior views of a case.

12. Insertion of the needle through the pterygomandibular ligament. This ligament is sometimes cartilaginous and thus offers marked resistance. The needle should always be inserted either buccally or lingually from this ligament.

13. Use of a dull needle. The points of all needles should be regularly sharpened on a fine stone.

14. Use of a fine gage needle, unless one has a delicate sense of touch. In using any needle, and particularly a fine gage needle, an endeavor should be made to develop such a fine sense of touch that one can feel with the point of the needle when it is in the proper region.

15. Insertion of a needle with the bevel side away from the surface of the bone, allowing the sharp point suddenly to catch in any irregularity on the surface of the bone.

16. Injection of the solution more rapidly than the tissues can absorb it, thus causing pain and a tendency for the patient to move the head. The refined technic mentioned in paragraph 5 will hasten absorption.

17. Striking of the lingual or inferior dental nerve with the needle, producing an "electric shock" type of pain and causing the patient to move the head suddenly.

18. An effort to follow some "named" technic. Success in block anesthesia results from a thorough knowledge of nerve supply and anatomy plus the application of common sense to the process of inserting a hypodermic needle. One must develop his own individual technic.

ROENTGENOGRAPHIC LOCALIZATION

Before removal of a broken hypodermic needle, the exact position of the

Fig. 4.—Direct lateral view of broken needle in contact with transverse process of vertebra.

needle must be determined in relation to bone landmarks, and to some radiopaque object placed in the tissues in the approximate location of the broken needle. The latter is usually a hypodermic needle having on its proximal end a knob or right angled bend. The needle is inserted until this proximal end is in contact with the surface tissue and this contact should be maintained throughout the operation.

One important thing to remember is that, in taking the roentgenograms, the mouth should be kept open by means of a prop since the operation

must be performed with the mouth open. Opening and closing the mouth can vary considerably the relation between the needle and surrounding landmarks.

Two roentgenographic views are sufficient, one lateral and one postero-anterior. The lateral view indicates the exact distance of the broken needle above, below, in front of or back of the landmarks. The postero-anterior view indicates its distance buccally or lingually from the guide needle.

The lateral roentgenogram should not be taken from the angle usually used for a film of one side of the mandible. Such an angle, which throws the shadow of the proximal side of the mandible upward, does not give a true relation of the needle to the landmarks.

The x-ray machine should be placed close to the cheek on the side op-

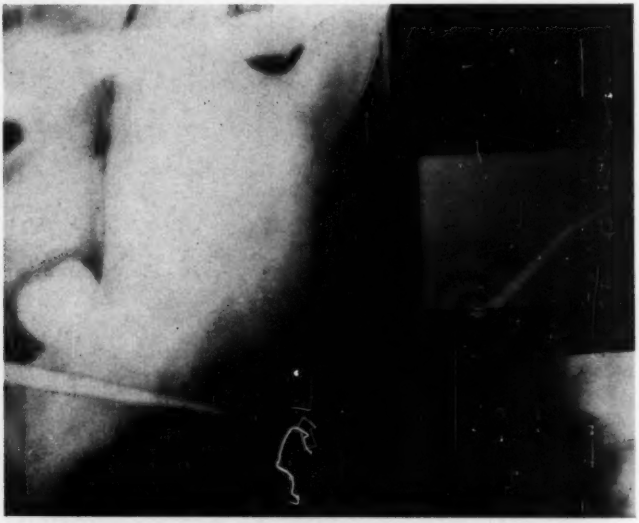

Fig. 5.—Lateral view and postero-anterior view showing broken needle under base of tongue; corkscrew tenaculum attached to tissue at proximal end.

posite the broken needle, with the rays directed horizontally, and the ramus on this side superimposed exactly over the ramus adjoining the needle. (Fig. 1, A and B.) Since the shadow of the ramus next to the x-ray machine will be enlarged and less distinct than the one next to the film, there is no difficulty in distinguishing between them.

The postero-anterior view is usually obtained by placing a dental film in the mouth in the third molar region, in a vertical position, with the upper and lower edges held by biting against the film. The plane of the film should be at right angles to the plane of the inner surface of the ramus

and the rays directed horizontally forward from behind the ear in a direction to be parallel to this inner surface, which, it should be remembered, flares outward. (Fig. 2, A, B and C.) Other methods of obtaining the information required by this view have been given in a previous paper.[1]

REMOVAL OF THE NEEDLE

In the removal of a broken needle from the throat, the most important structures to be considered are the lingual nerve, the inferior dental nerve, the inferior dental artery and the pterygomandibular ligament.

The responsibility of the operator concerning the first three structures

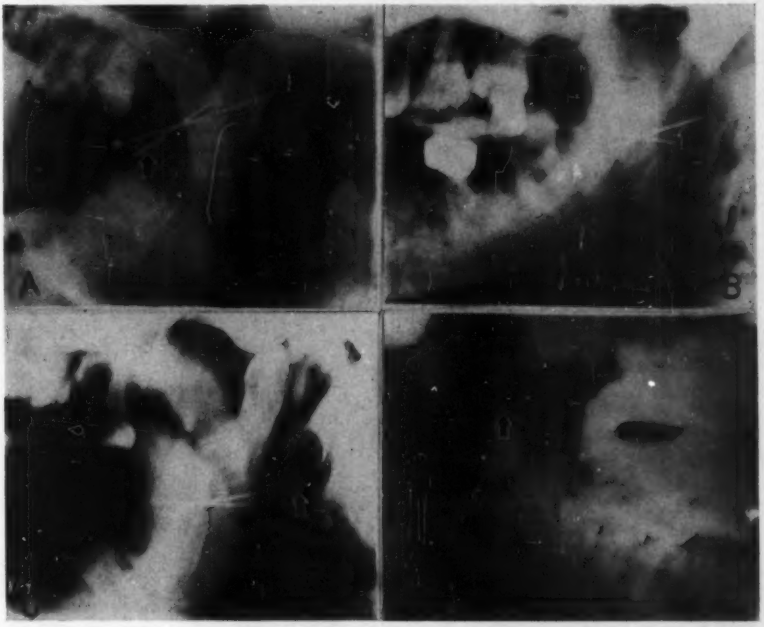

Fig. 6.—A. Direct lateral view showing broken needle beneath coronoid notch. B. Direct lateral view showing end of broken needle distally from posterior border of mandible. C. Direct lateral view showing end of broken needle about 1 cm. distally from posterior border of mandible. D. Direct lateral view showing end of broken needle near anterior portion of base of condyle.

should be obvious, but few operators seem to consider the undesirable results of incision of the pterygomandibular ligament, that important structure which unites the superior constrictor of the pharynx and the buccinator muscle. If this ligament is severed, it is, in most cases, almost an impossibility to suture it in the proper relationship, and the postoperative result is a ptosis of the soft palate on that side.

To avoid this ligament, and the lingual nerve, which may have a variable location close to the surface, the incision is begun buccally from the lower third molar region and extended upward along the anterior border of the ramus, thus being in cheek tissue for almost its entire length. The incision is very shallow, just through the superficial tissues, and, from this depth, the operation proceeds by blunt dissection only.

The tissues are dissected for a short distance above and below the level of the broken needle and the dissection is extended distally along the inner surface of the ramus, next to the periosteum, but not elevating it from the bone. If, during this procedure, the lingual nerve is exposed, as is often the case, it is held to one side to avoid injury. The dissection is continued distally until the tissues are opened to a point opposite the anterior portion of the broken needle.

When this point has been reached, it is evident that the broken needle must be lingually from the deepest area opened by the blunt dissection and the roentgenogram should indicate fairly accurately its position in relation to the metal landmark, which is still in position.

The next step is to separate the fibers of the internal pterygoid muscle lingually from the depth of the dissection. The fibers are separated in one plane only, and this separation extends slightly above and below the level of the needle. This is done with a tenaculum, and the separation of the fibers is continued lingually until the anterior portion or the proximal end of the broken needle is brought in view. It is then carefully grasped with a hemostat and withdrawn.

The margins of the incision naturally approximate themselves, but should be sutured to avoid displacement. No drain is necessary unless undue injury has been inflicted on the tissues.

GENERAL COMMENTS

The more time spent in accurate localization of the needle, the less time will be required to complete the operation.

As one becomes more experienced in searching for needles, the incision will be shorter and of less depth. One eventually reaches that point in proficiency at which he operates through a very small incision and searches for the proximal end of the needle only, which results in a minimum of postoperative reaction.

Following the foregoing principles of technic sounds easy, and it *is* comparatively easy for one who has surgical training, surgical judgment and experience in operating in this region. I have used this technic for more than twenty years, and it has been 100 per cent successful, most of the broken needles having been removed within ten minutes. When more time is necessary, localization is inaccurate, usually because the x-ray machine in the postero-anterior view is not pointed so that the rays are exactly parallel to the inner surface of the ramus. If the needle is not recovered

immediately after its supposed position has been reached, rather than damage tissue by further blind search a tenaculum or other suitable instrument should be attached to the tissue in this region and the needle should then be relocalized roentgenographically.

These operations are all performed under procaine anesthesia, with a higher than usual percentage of epinephrine. Block anesthesia allows for the utmost cooperation of the patient, and the higher epinephrine content of the anesthetic makes the field of operation comparatively bloodless.

One should keep in mind that x-rays diverge, that their source is a point and that, unless the projected line extending from the target of the x-ray machine to the proximal end of the broken needle contacts the x-ray film exactly perpendicularly to the plane of the latter, the images will not be in their exact relation.

A more detailed description of some phases of this technic and a discussion of why all broken needles should be removed at the earliest opportunity were given in previous papers.[1, 2]

I should repeat here, because it can have a valuable application in war wounds, that radio earphones are of great assistance in locating needles or other metallic foreign bodies in complicated cases when direct vision is obscured. The operator adjusts the earphones, has the patient hold one terminal and attaches the other terminal to the exploring instrument. Whenever the exploring instrument touches metal in the tissues, a click or grating sound is heard in the earphones. No battery is necessary.

BIBLIOGRAPHY

1. THOMAS, E. H.: Removal of Broken Hypodermic Needles. J.A.D.A., 19:1747-1755, October 1932.

2. *Idem:* Broken Hypodermic Needles in the Oral Tissues. *Illinois D. J.*, 4:388-394, October 1935.

55 East Washington Street

The Development of Oral Surgery.—The third factor influencing not only the development of oral surgery, but of dentistry, has revolutionized the whole profession. This is, the unfolding of the knowledge in this period of the relationship of pathology of the mouth to general pathology of the body. In all probability no stimulus has been given to any profession equal to this one. Dentistry was suddenly faced with the tremendous responsibility of helping to solve this problem. I believe there has been no single stimulus to dental education that has been comparable to this.—Chalmers J. Lyons, D.D.S., D.D.Sc., History of Oral Surgery, Dental Cosmos, Vol. 76, Jan. 1934.

UMI

DEEP INFECTIONS OF THE NECK OF DENTAL ORIGIN*

FRANK S. TICHY,† D.D.S., Evanston, Ill.

THE oral cavity, with its ever-present infective conditions, and by the nature of its bony architecture, is a common site for conditions which terminate in deep abscesses of the neck. This is particularly true when the soft tissues of the mouth are broken by trauma, incision or a lesion, at a time when ordinary mouth hygiene is neglected.

The mouth is richly supplied with lymphatics. Through lymph drainage, the deep fascial planes become easily involved, and the conditions that arise often terminate in deep cervical abscesses. The shape and architecture of the mandible are such that the retromolar area, with its covering of lymph tissue, is commonly subjected to severe surgical damage during the removal of an embedded or impacted third molar. This area is a common site of postextraction infection, with its sequelae.

If the field of operation is septic, and no attempt is made to establish surgical cleanliness, an infection will follow which may terminate in a deep cervical abscess. Therefore, extraction of a tooth, particularly an impacted tooth, should be attended by surgical cleanliness, and followed by postsurgical care and observation, until repair and healing of the wound have taken place.

Deep abscesses of dental origin may arise in three ways: first, by direct extension; second, from extensively lacerated wounds, and, third, through the blood stream in the form of infected emboli. However, deep infections of a hematogenous type are much less frequent than those originating by direct extension. The organism most commonly responsible for these infections is *Borrelia vincenti*, although the streptococcus, staphylococcus, diplococcus or *Bacillus septicus* may be responsible.

The conditions that lead to a breakdown of normal tissue resistance are: (1) lowered body resistance, (2) poor mouth hygiene, (3) dental caries and disease of the gums, (4) the presence of pathologic organisms in the mouth and (5) surgical trauma.

1. Lowered body resistance may be attributed to: (a) syphilis, (b) tuberculosis, (c) Banti's disease and general leukemia, (d) scurvy or avitaminosis or (e) diabetes.

2. Poor mouth hygiene may result from: (a) lack of oral cleanliness,

---

†Commander (DC), U. S. Navy.

*All opinions or statements contained herein are those of the writer and are not to be construed as official or the views of the Navy Department or the Naval service at large.

(b) faulty interdental contact, (c) poorly fitted bridges, faulty prostheses or poor fillings and (d) salivary and serumal deposits.

3. Disease conditions of the teeth and investing structures may result from: (a) dental caries, (b) gingivitis, (c) paradentosis, (d) impaction of teeth and (e) abscess of the teeth.

4. Common pathologic organisms of the mouth are: (a) *Borrelia vincenti,* (b) the staphylococcus, (c) the streptococcus, (d) the diplococcus and (e) *Bacillus septicus.*

5. Surgical trauma may consist in: (a) stripping of the periosteum, (b) fragmentation of bone and teeth, (c) extensive exposure of bone, (d) packing for the control of hemorrhage and (e) a faulty technic in the use of anesthesia.

SYMPTOMS AND DIAGNOSIS

Localized pain, tenderness, redness and edema of the overlying tissues are the usual outward signs. Systemic manifestations of infection such as chills, fever, malaise and a distinct feeling of apprehension are present. The blood picture consists of a leukocytosis averaging 15,000 white blood cells, 80 per cent usually being polymorphonuclears. These acute inflammatory lesions (phlegmons) follow the same pathologic course and "represent degrees varying in virulence of one and the same process." (Semon.)

TREATMENT

The treatment of phlegmons of the neck can be divided into three phases: (1) medical, (2) roentgenologic and (3) surgical.

1. Medical treatment: This consists primarily of rest and immediate hospitalization, saline catharsis, forcing of fluids by mouth and hypodermoclysis and the use of hypnotics (morphine or codeine preferred). Application of local continuous hot boric compresses to the neck is beneficial. It appears that the boric acid assists in reducing the virulence of the infection. Sulfathiazole is given as follows: first day: 30 grains at 2 p.m., 15 at 6 p.m., 10 p.m., 2 a.m. and 6 a.m. (90 grains in all). Second day: 15 grains at 10 a.m., 2 p.m., 6 p.m., 10 p.m., 2 a.m. and 6 a.m. (180 grains). Third day: 15 grains at 10 a.m., 2 p.m., 6 p.m., 10 p.m., 2 a.m. and 6 a.m. (270 grains). Fourth day: 15 grains at 10 a.m. and 2 p.m. (A total of 300 grains.)

2. Roentgenologic measures: Irradiation with the x-rays is staggered during the medical treatment, as outlined, and the value of this measure cannot be overemphasized. We have found it more helpful than anything else to combat the boardlike induration of the affected part. X-ray irradiation softens the area of induration and aids in restoring the blood circulation to normal.

We have not found any contraindications to irradiation during the use of the sulfonamides, as some have suggested. The following x-ray dosage

UMI

is recommended:

First day: K.V.P. 100: ma. 3, roentgens 110-1 mm.Al.fil.

Third day: K.V.P. 100: ma. 3, roentgens 75-1 mm.Al.fil.

Fifth day: K.V.P. 100: ma. 3, roentgens 75-1 mm.Al.fil.

The rays are directed to the affected site.

3. Surgical measures: It must be remembered that surgery has no part in the treatment of these acute phlegmons or acute abscesses during the first week or ten days.

Indications for surgery are usually noted by local swelling and a pitted edema of the pathologic field. The underlying pressure may result in a blanching of the swollen superficial structures and skin. Dysphagia and difficult respiration are often encountered. This phase of the treatment is usually instituted at about the tenth day of the infection.

Should surgical procedure be indicated after this period of time, a linear incision is made parallel to and about 3 cm. below the lower border of the mandible on the affected side.

This approach to the submaxillary space is followed by a careful blunt dissection medially, directed upward and back to an approximate depth of 4 cm. We have observed that, in all cases, these phlegmons begin unilaterally, and, in 80 per cent of cases, excellent drainage is established by this method.

If, however, the abscess has developed in the pharyngomaxillary fossa and the upper portion of the pharynx, an oblique incision directly behind the angle of the mandible can be made. The two incisions described are made for drainage in one and the same case.

"In both these incisions, the styloid process is the guide to the great vessels. They lie at the same depth as the process and behind it." (Mosher.) One need not hesitate in making these incisions provided the patient receives the supportive and medical treatment outlined for the first ten days. All surgical work is done under procaine anesthesia.

REPORT OF CASES

CASE 1.—*History.*—J. L., a man, aged 21, Negro, single, admitted February 10, 1939, gave a history that was essentially negative. The mother, father and two brothers were living. One sister died in infancy. The patient had had the diseases of childhood, but according to his statement had had no venereal disease. He had been active until very recently, when pain and soreness in the right side of the jaw and face caused him to seek dental relief.

Examination.—The patient was muscular and well developed. He was restless and appeared to be very apprehensive. The right side of the face, jaw and neck appeared swollen. There was some difficulty in swallowing and in speaking. The temperature was 102°F.; pulse, 100; respiration, 34. There was some adenopathy. The submaxillary glands were enlarged, especially on the right side. The lymph nodes of the neck were palpable. The mouth could be opened only partly and with effort and pain, evidently owing to trismus and swelling.

The teeth and the investing structures were normal, except for the lower right third molar region. This molar had been removed twenty-four hours previously. The postextraction wound seemed to be in satisfactory condition.

The onset of the swelling occurred a few hours after the extraction, increasing during a hectic and sleepless night. The posterior wall of the pharynx and the fauces were slightly injected. The retromolar region and the pillar, right side, were injected and slightly swollen.

Laboratory Examination.—A smear taken from the gums showed a few *Borrelia vincenti* organisms. The Wassermann reaction was negative; urine, cloudy, with a few casts; specific gravity, 1.025; white blood cells, 14,000; polymorphonuclears, 75 per cent.

Diagnosis.—Cellulitis of the neck, right side and abscess of the submaxillary space, right side was the diagnosis. The prognosis was believed favorable.

Treatment.—Supportive and symptomatic measures were employed. Continuous hot boric compresses were applied. Sulfathiazole 300 grains was routinely administered by mouth over a period of four days.

February 12, the compresses were continued. The temperature was 103° F.; pulse, 110, respiration, 34. The following x-ray irradiation, directed to the affected part, was given; first day, K.V.P. 100, ma.3, roentgens 110; third day, K.V.P. 100, ma.3, roentgens 75; fifth day, K.V.P. 100, ma.3, roentgens 75.

February 13, the temperature, pulse rate and respiration rate continued to rise, although the boardlike structures appeared to have softened. There was some sloughing of the oral mucosa, particularly in the floor of the mouth. Foul breath was noted. Potassium permanganate 1:5,000 aqueous solution was given freely as a mouth wash.

February 15, the postextraction wound was wide open, exposing some of the bone. The surrounding soft tissues appeared engorged and red.

February 20, there was slight pitting of the swelling of the structures in the submaxillary region, right side. A soapsuds enema was ordered.

February 21, the swelling appeared to have localized at a point in the shadow line of the mandible, right side. The swelling pitted very easily. Surgical incision for drainage was indicated. The patient was prepared for surgical measures for drainage. Under infiltration block procaine anesthesia of the submaxillary region, right side, an incision was made just below the body of the mandible, right side. With blunt dissection, and a hemostat directed into the wound upward and back, a generous flow of dark foul smelling pus was started. A rubber drain was inserted. The wet boric compresses were continued.

February 22, the patient appeared cheerful. The dressing was changed daily.

February 25, the drain was removed and the patient was up and about. The wound in the mouth looked satisfactory.

February 28, a small bone sequestrum was removed from the mouth wound. The drainage wound was almost healed. The patient was discharged as well.

CASE 2.—*History.*—W. M. W., a white man, aged 29, married, with no children, admitted July 15, 1939, gave a history of having had the diseases of childhood and no venereal disease. He was subject to frequent attacks of sore throat, also of sore gums. The mother died at the age of 52 of coronary thrombosis. The father and a sister were living and well.

Examination.—The patient was of sallow complexion. He was 69 inches tall and was underweight. The mandible appeared underdeveloped and the lower lip was pendulous. There was an indurated swelling of the lower part of the face and the neck on the right side. The patient seemed tired and enervated. There was some rise in temperature and in pulse and respiration rates. The cervical glands were palpable. The mouth was opened rather carefully. Dental examination revealed the two dental arches to be narrow, malocclusion and an open bite resulting. Extensive dental caries and spongy gums were noted. The right lower third molar had been removed about forty-eight hours previously. The extraction wound was open, with no blood clot. The wound was packed with detritus.

The onset occurred a day after the tooth was extracted. Not much pain was experienced, except at night. The posterior wall of the pharynx and the fauces were injected. The tonsils were enlarged. The gums bled easily and were spongy and beefy red.

Laboratory Examination.—Smears taken from the gums showed many *Borrelia vincenti* organisms. The urine was negative; Wassermann reaction, negative; two blood cultures, negative. The white blood cells numbered 12,000, with polymorphonuclears 70 per cent.

Diagnosis.—Cellulitis of the neck, right side, following extraction of a tooth, was the diagnosis. The prognosis was considered favorable.

Treatment.—Saline catharsis was given. Hot boric dressings were applied to the side of the jaw continuously. A potassium permanganate solution 1 :3,000 was used freely as a mouth wash. Codeine was given when indicated.

July 17, no change was apparent. There was loss of appetite. The patient was given plenty of fluids. A very foul breath was noted. The gums were swabbed with mapharsen 0.6 gm. in 50 ml. of glycerin twice daily. Routinely, sulfathiazole 300 gm. was given over a period of four days. Routine x-ray irradition was instituted.

July 19, there was a dirty grayish foul-smelling slough on the right side of the jaws and the throat. There appeared to be no marked change as to the texture and extent of the swelling of the face and neck on the right side. The patient continued to be listless. The temperature was 101° F.; pulse, 85; respiration, 30.

July 22, the swelling appeared less diffuse and pitted readily. There was no marked change.

July 23, the patient seemed to take more interest in things around him and enjoyed a quart of orange juice. There was evidence of fluctuation at the angle of the right side of the mandible. A sinus discharging foul-smelling pus developed in the floor of the mouth, opposite the socket of the recently extracted tooth. Under procaine anesthesia, an incision was made at the angle of the mandible on the right side. An almost immediate flow of pus started, yielding approximately 2 fluid ounces of pus. A rubber drain was inserted. The hot compresses of boric acid solution were continued.

July 25, the patient showed decided improvement.

July 27, the rubber drains were discontinued.

July 29, the patient was discharged as well.

SUMMARY

1. Causative factors in the neck lesions described are usually dental.

2. More than 100 cases of deep phlegmons of the neck were treated, with no fatalities, by the method described.

BIBLIOGRAPHY

MOSHER, H. P.: *Laryngoscope*, 30:365, June 1920.

ALDEN, A. M.: Deep Neck Infection Secondary to Dental Disease. *J.A.D.A.*, 23:854, May 1936.

DINGMAN, R. O.: *Am. J. Orthodontics*, 25:780, August 1939.

LEDERER, F. L., and FISHMAN, L. Z.: Phlegmons, Including Fascial Sheath Infections of Face and Neck of Dental Origin. *J.A.D.A.*, 27:1439, September 1940.

MEAD, S. V.: *J. Tennessee D. A.*, 21, April 1941.

DEAN, quoted by H. P. Mosher, first reference.

WISOFF, JULIUS: *D. Outlook*, 23:405, September 1936.

CHRISTOPHER, FREDERICK (editor): Textbook of Surgery. Ed. 3. Philadelphia: W. B. Saunders Co., 1942.

Navy Training School, Navy Pier.

ACUTE INFECTIONS OF DENTAL ORIGIN

Acute alveolar abscess and cellulitis with or without infection of the fascial spaces of the face and neck and unassociated with the recent extraction of a tooth offer a great problem to the dentist. The patient's one idea is to obtain prompt relief by the removal of the infected tooth. The dentist has been warned by numerous experienced surgeons that extraction of the tooth in the early stages of abscess formation, when accompanied by swelling and cellulitis, is a dangerous procedure. At this time, the local tissue defenses against the infection have not fully developed and the opening up of bone spaces in the tooth socket exposes them to invasion by virulent micro-organisms from the root end or cervical regions. This may by further extension result in an acute osteomyelitis with consequent loss of a number of teeth, necrosis and sequestration of bone. Many months of treatment and disability or even death may ensue. In some cases, deep infection of the fascial planes or septicemia may develop rather than osteomyelitis.

The dentist is correct in exercising caution in cases of this type but is beset with doubt regarding the proper handling of the patient, who may be impatient and may consult several dentists in turn, to find one who will extract the tooth. Fortunately, most patients recover without serious complication and the first dentist is condemned as one lacking in the ability to handle such conditions.

Further clinical research in sulfonamide therapy in oral surgery may well make possible the formulation of a more or less routine plan of treatment in these disturbing cases. Already enough has been done to lend encouragement to the hope that dentists may soon be given authentic information for use in caring for serious infections of the jaws and associated tissues.—C. W. Waldron.

RELIABILITY OF RADIODONTIC EVIDENCE

CLARENCE O. SIMPSON, M.D., D.D.S., St. Louis, Mo.

IN THE early days of radiodontic practice, it was a frequent comment of older dentists that the x-rays lie. Since no proof of this statement was submitted, no one made the effort to disprove it, as might have been done. The images produced on a film or a fluoroscopic screen by the x-rays are subject to physical laws which are constant. A considerable proportion of dentists who still do not believe that radiographs are reliable have not learned the application of these laws, and that radiodontic evidence may be deceptive but not false.

There are several factors in any change in the appearance of images of the same group of objects or structures. Different types of film will alter the appearance of the images, often to the extent of being misleading. An excess of voltage, milliamperage, exposure or development will decrease the contrast of the images, unless there is a compensatory change in other factors. When the excess is sufficient to constitute a technical error, the images of some of the objects or structures may not be visible. A deficiency in any of these factors may fail to reveal the evidence of caries, bone destruction or fracture.

The most deceptive factor is the projection and superimposition of images. A tooth 25 mm. long may be projected to produce an image either 20 or 30 mm. long. The destruction of alveolar bone 5 mm. in diameter may be obscured. A fracture of a tooth or bone without displacement of the parts may not be registered. An object near the apices of teeth may be projected on either the labial or the lingual side of the teeth. Particles of lead glass in the cone of an x-ray machine are projected on radiographs, without the operator's suspecting the source of the peculiar images. These occurrences cause distrust of radiodontic evidence, but they are all explainable. A fundamental principle is that a radiodontic interpretation should not be made without a sufficient number of technically acceptable views to establish the evidence.

The following description of a radiodontic examination, interpretation and diagnosis should emphasize the necessity of making different views routinely before attempting interpretation. Following an operation for the removal of a left mandibular third molar, the patient developed a severe inflammation with trismus. Since a finger could not be inserted between the incisal edges of the teeth for manipulation of film packets, an extra-oral view (Fig. 1) was made. Without information as to what was accomplished or what was injured by the operation for removal of the third molar, Figure 1 suggested the presence of tooth fragments in the wound.

UMI

Fig. 1.—Extra-oral view suggesting tooth fragments remaining after operation for removal of third molar.

Fig. 2.—Extra-oral view in which suspicious objects are projected on first and second molars.

UMI

Another extra-oral view (Fig. 2) was made which projected the suspicious objects on the first and second molars. This marked change in the location of the images indicated that the objects were a considerable distance from the left third molar region. It was possible to insert a film packet for an occlusal view, which disclosed that there was no fragment in the left third molar region (Fig. 3, left). An occlusal view of the right side (Fig. 3, right) revealed a calculus in Wharton's duct and the submaxillary gland, which had been projected on the left third molar region in the extra-oral

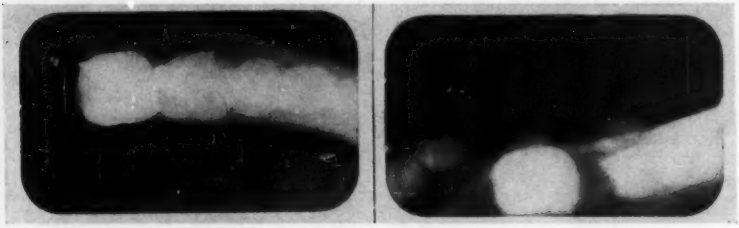

Fig. 3.—Left: Occlusal view excluding tooth fragments in left third molar region. Right: Occlusal view of right side revealing calculus in Wharton's duct and submaxillary gland which had been projected on left third molar region in Figure 1.

view. This evidence established a diagnosis of an infected wound, uncomplicated by fragments, and therefore not requiring another operation in this location, which would have precariously interfered with recovery. Radiographic localization of the objects was surely preferable to surgical exploration of an infected wound.

919 University Club Building.

Causes of Surgical Diseases of the Mouth.—The Surgical Diseases of the Mouth, if studied with reference to their causes, their nature, their varieties, their progress, the parts involved, the period of life most subject to attack, and also the operations and modes of treatment demanded, form no small part of the art of healing. They demand not simply a general, but a special and careful consideration; else will the routine practitioner expose those affections, either to dangerous operations, or to a course of treatment, tedious, useless, and it may be, hurtful. Instead of curing the disease, he will but add to the list of ills.—Surgical Diseases of the Mouth, Jourdain, 1778.

THE PROPHYLACTIC USE OF SULFATHIAZOLE IN TRANSIENT BACTEREMIA FOLLOWING THE EXTRACTION OF TEETH

A PRELIMINARY REPORT

PHILIP M. NORTHROP, M.S., D.D.S., and MARY C. CROWLEY, A.B., M.S.P.H., Ann Arbor, Mich.

THE fact is well established that as a result of trauma of surgical procedures, showers of organisms are frequently carried into the blood stream. Such a bacteremia is transient, the organisms remaining in the blood stream only for about three to five minutes, after which time they disappear. In the normal individual, such a bacteremia is of little or no significance. However, in the patient with valvular heart disease, an entirely different situation exists. When micro-organisms are circulating in the blood stream, the latter type of patient immediately becomes a candidate for the usually fatal subacute bacterial endocarditis.

Richards,[1] in 1920, in a study of arthritis and chorea, was probably the first to present the interesting observation that manipulation of affected joints caused bacteria to be thrown into the blood stream. He obtained positive blood cultures in 14 per cent of fifty-six cases. With these results in mind, the same author,[2] in 1932, made a much more extensive study, including not only joints, but also tonsils, gums and prostates. He also studied boils. This investigation consisted of a study of 376 cases. Cultures before manipulation were negative except for one patient, who had walked a short distance before the culture was taken. Cultures taken immediately after trauma showed positive cultures in 14 per cent of cases.

Butler,[3] in her book "Blood Cultures and Their Significance," refers to the findings of Seifert (1925), who showed that a bacteremia frequently followed surgical intervention and that its incidence was greater in cases in which the infection was acute than when it was chronic. Butler also mentions the work of Lehman (1926), who cultivated *B. welchii* from blood cultures made immediately after curettage in eighteen of 100 abortions. These cases of bacteremia were transient and in no way complicated the patient's convalescence.

Transient bacteremia following urologic manipulation has been reported by Scott[4] and Barrington.[5]

The same phenomenon has also been shown to follow surgical procedures in the throat. Elliot reviewed the literature on this particular phase of the problem. He made cultures immediately before and after tonsillectomy,

From the University of Michigan School of Dentistry.

obtaining thirty-eight positive blood cultures in those taken immediately after surgical measures. It is interesting to note that he also obtained positive blood cultures in 8.5 per cent of cases in which the blood samples were taken preoperatively.

The spectacular findings of O'Kell and Elliot[7] were the first to show that the same phenomenon followed the extraction of teeth. These investigators were interested primarily in the source of *Streptococcus viridans* found on the vegetations of hearts showing subacute bacterial endocarditis. In 138 cases, blood cultures were made before and immediately after extraction of teeth. The surgical procedure was carried out under general anesthesia. The results showed that a transitory bacteremia occurred in 64 per cent of the 138 cases. The patients were placed in three classes, their classification depending on the degree of oral sepsis present. In the severely septic and pyorrheal mouths, a bacteremia was found to follow surgical operations in 75 per cent of cases. Even in thirty-eight cases without recognizable oral sepsis, twelve patients, or 31.5 per cent, had positive blood cultures. Of the entire group, positive blood cultures were obtained preoperatively in twelve instances, 8.6 per cent. Except on four occasions, the organism isolated was *Streptococcus viridans*.

Elliott[8] later continued the work which he and O'Kell had started. In this study, he was primarily interested in determining the least amount of injury to the teeth that would induce a bacteremia. He reports that where there is marked gingival disease, the mere rocking of the tooth is sufficient to permit the organisms to enter the blood stream.

Murray and Moosnick[9] have shown that transient bacteremia follows the chewing of paraffin cubes for a period of one-half hour.

In the past few years, several well-conducted investigations have been made wherein blood cultures have been taken after the extraction of one or two teeth under local anesthesia.[10, 11] The incidence of bacteremia under these conditions has been found to be about 17 per cent. There is, therefore, a tremendous difference in the incidence of positive blood cultures following surgical operations under general anesthesia and that following the use of local anesthesia.

MODE OF ENTRANCE OF ORGANISMS IN THE BLOOD STREAM

Burket[10] and his associates showed that attempts to sterilize the gingival crevice were inadequate and that organisms in the gingival crevice could be forced into the blood stream during dental extractions. Fish and MacLean[12] also believe that organisms are pumped into the blood stream during the process of extraction.

It seems logical to assume that organisms may be carried into the blood stream through the apices of teeth or may enter the blood because of trauma

to the bony structures. The greatest portal of entry, however, is thought to be the soft tissues surrounding the teeth.

The lowered incidence of transient bacteremia under local anesthesia as compared with that of bacteremia obtained under general anesthesia can be attributed only to the vasoconstrictor action of the adrenalin that is incorporated in most local anesthetic solutions.

SIGNIFICANCE OF TRANSIENT BACTEREMIA

As previously mentioned, a transient bacteremia in the normal individual probably is of little or no significance, since the blood stream quickly destroys the newly introduced organisms. However, it has been reported[2, 7, 8, 9] that, in some individuals, when there is severe oral sepis and pyorrhea, bacteremia may occur frequently merely from trauma during mastication.

Streptococcus viridans, a common inhabitant of the gastro-intestinal tract, is the most common organism found in the oral cavity. It is also the organism most frequently found in the blood stream during transient bacteremia. Since subacute bacterial endocarditis is, in most instances, the result of localization of *Streptococcus viridans,* on previously damaged heart valves, it becomes apparent that such bacteremia may be of grave significance in the etiology of this usually fatal disease. Although Lichtman and Burman[13] have reported recovery in from 6 to 25 per cent of their cases, with various methods of treatment, most authorities agree that this disease virtually always has a fatal outcome.

SUBACUTE BACTERIAL ENDOCARDITIS

Schwartz and Salman[14] presented an interesting view of the relationship of extraction of teeth to subacute bacterial endocarditis, in which they refute the entire thought that surgical procedures in any way cause the onset of the disease. In a study of 136 patients, in active and inactive phases of rheumatic fever, extraction of teeth under local anesthesia resulted in the death of one boy in whom an extensive cellulitis, and lymphatic involvement of the deep tissues, existed at the time of operation. The authors believe that extraction in this type of individual entails no greater risk than in individuals with normal hearts.

Subacute bacterial endocarditis is characterized by the formation on the heart of vegetations, which are nearly always due to *Streptococcus viridans. B. influenzae* is found in a few cases and, rarely, the gonococcus. Many times, this disturbance is easily overlooked until the disease is well established, because of its insidious onset. The patient may have a low fever, usually not over 101°F. In fact, he may, for several weeks, scarcely be aware that he is ill. As the disease continues, the symptoms become more definite and diagnosis is easier. The patient develops a progressive anemia as well as embolic phenomena. The latter manifest themselves

by petechial hemorrhages in the skin or under the nails. Emboli may settle in various organs, such as the kidneys, an albuminuria and transitory hematuria resulting. Heart symptoms are not prominent, unless an old lesion is recognized. The patients may live six months or a year, although frequently death may occur a few months or weeks after the symptoms are established.

Hadfield and Barrod,[15] in their book "Recent Advances in Pathology," state that Thayer proved 80 per cent of persons with subacute bacterial endocarditis to have had heart lesions; 65 per cent of cases to be due to an attack of rheumatic fever, and 15 per cent to result from congenital valvular malformation.

Bartels,[16] commenting on the work of Grant as mentioned in Hadfield's book, says:

> Grant discovered that the heart valves injured from rheumatic fever or congenital malformations are readily traumatized in the performance of their mechanical function. Minute blood platelet thrombi form at the site for the colonization of Streptococcus viridans. Histologically the vegetations thus formed have been found to consist of several zones. In contact with the blood stream is the outer zone of fibrin, and immediately below it are found the colonies of streptococci. Directly beneath the bacteria is a zone of leukocytes which rests on a layer of granulations attached in turn to a fibrotic base. From time to time clumps of streptococci are torn loose from the vegetations and pass into the circulation as emboli. While the blood becomes bactericidal to the streptococcus, yet, due probably to the protection afforded by the fibrin of the vegetation, the antibodies of the blood are unable to destroy the microorganisms.

Subacute bacterial endocarditis directly resulting from tooth extraction has been reported by many investigators: Rushton,[17] Feldman,[18] Bernstein,[19] Weise,[20] Sale[21] and Elliot.[8]

Recently, we reviewed the histories of cases of subacute bacterial endocarditis treated at the University Hospital in the past seventeen years. Some of the findings are given here, since it is believed that several facts are significant in the present study.

The number of patients treated was 138. The average age was 28.5 years. Patients giving a history of previous rheumatic fever or chorea numbered seventy, or about 50 per cent. The number of patients in this group with other cardiac disease was thirteen.

Of the total 138 cases, fifty-four (Table 1), or 38 per cent, gave histories of previous surgical trauma or serious illness prior to the onset of symptoms. An interesting fact noted was that, many times, apparently no definite inquiry was made by the examining physician as to the possibility of recent injury or trauma, for, in fifteen instances, this information was obtained only through some statement made later in the history. It is our conviction that had a history been more carefully taken in this group, this incidence of predisposing factors would be much greater.

In order to carry out a study on the effect of sulfathiazole on transient bacteremia following the extraction of teeth, we felt it necessary to establish a series of control cases. In this way, we could check on previous reports and also standardize our own procedure. No attempt was made to select any specific type of case, or even to limit the number of extractions to one or two teeth. All types of exodontia were included in this series. Besides simple extraction, multiple extraction, root resection, removal of impacted teeth, etc., were performed. The surgical procedures were carried out by students using 2 per cent procaine with 1:50,000 adrenalin.

BACTERIOLOGIC TECHNIC AND RESULTS IN CONTROL GROUP

Ninety-seven series of blood cultures were made in the control group. A series consisted of three blood samples from each patient, one before operation and one immediately and another ten minutes after completion of the operation. Ten cubic centimeters of blood was taken for each culture, and added to approximately 100 cc. of beef infusion broth pH 7.4 containing 0.1 per cent glucose. All blood cultures were incubated at 37.5°C. for two weeks before being discarded. When any cloudiness suggesting growth was noted, the culture was plated out on blood-agar. Otherwise, cultures were plated at the end of seven days and again on the fourteenth day. All blood plates were incubated at 37.5°C. for three days before being discarded as negative.

TABLE 1.—TYPES OF TRAUMA UNDERGONE AND INFECTION PRESENT SHORTLY BEFORE THE ONSET OF SUBACUTE BACTERIAL ENDOCARDITIS

Predisposing Factors	Number
Dental extractions	23
Severe cold	7
Dislocation of hip	1
Appendectomy	2
Cellulitis following bee sting	1
Pyelonephritis	2
Fracture of femur with osteomyelitis	2
Dilation and curettage	2
Prostatitis	1
Toxoid injection	1
Otitis media	1
Tonsillectomy	4
Self-induced abortion	2
Severe gingival disease	1
Cesarean section	1
Abscess of thumb	2
Herniorrhaphy	1
Total	54

Cultures preliminary to operation were negative with two exceptions. The organism isolated in both of these cases was *Staphylococcus albus,* which we considered to be the result of contamination. The results of

cultures taken immediately on completion of operation can be seen in Table 2. *Streptococcus viridans* was isolated four times, the anhemolytic streptococcus three times and the anaerobic streptococcus once (this organism grew in the original broth culture, but could be grown on blood plates only under anaerobic conditions); *Streptococcus viridans* with *Staphylococcus albus* once (*Staphylococcus albus* is probably the result of contamination); *Streptococcus viridans* with actinomyces once; the anhemolytic streptococcus with actinomyces once, and actinomyces alone once. We are inclined to consider the actinomyces of some significance, since several authors[22, 23, 24, 25] have reported the presence of actinomyces in the oral flora. The remaining organisms isolated, namely a diphtheroid, a spore former and *Staphylococcus albus*, we consider the result of contamination. With the last three named discarded, the incidence of positive cultures immediately following operation was twelve, or 12.8 per cent, while eighty-one, or 87.2 per cent, were

TABLE 2.—CONTROL GROUP: RESULTS OF CULTURES IMMEDIATELY FOLLOWING OPERATIVE PROCEDURES

Organisms	Times Isolated
Streptococcus viridans	4
Anhemolytic streptococcus	3
Anaerobic streptococcus	1
Streptococcus viridans and Staphylococcus albus	1
Streptococcus viridans and actinomyces	1
Anhemolytic streptococcus and actinomyces	1
Actinomyces	1
Diphtheroid	1
Spore-former	1
Staphylococcus albus	1
Negative	81
Total	96

negative. This percentage compares favorably with the 17 per cent usually reported by other workers. The operative procedures in our study were carried out by students, and the increase in operating time resulting may account for the slight difference in the number of positive cultures.

Cultures taken ten minutes after completion of operation were negative with one exception. The organism was *Staphylococcus aureus*. In the same case, the culture taken immediately after operation was negative; therefore, a positive culture ten minutes after operation would have doubtful significance.

PROPHYLACTIC USE OF SULFATHIAZOLE

Since the beginning of this study appreciating the frequency of bacteremia following surgical procedures in the oral cavity and its probable relationship to subacute bacterial endocarditis, it has been our intent to treat

a series of patients under the same conditions as our control series,but given premedication with sulfathiazole. We were aware that the anhemolytic streptococcus had been thought to be unaffected by the bacteriostatic action of the sulfa drugs. Nevertheless, it was our hope that such prophylactic treatment might still play a role in decreasing the incidence of positive cultures following surgical operations. Therefore, all patients in this series were given 6 gm. of sulfathiazole and sodium bicarbonate before operation, 1 gm. of each being given every four hours, starting at 4 o'clock the day before appointment and terminating at 12 o'clock noon. The surgical procedure was carried out early in the afternoon, one to two hours after the last administration of the two drugs.

Recently, Hopkins,[26] although giving no specific number of cases treated, stated that all patients treated prophylactically with sulfanilamide gave negative blood cultures following the extraction of teeth.

Budnitz and his group[27] used sulfapyridine in twenty-seven cases with valvular disease, and obtained no positive blood cultures after, or reaction from, surgical procedures.

BACTERIOLOGIC TECHNIC AND RESULTS IN THE SULFATHIAZOLE-TREATED GROUP

In the group treated with sulfathiazole, seventy-three series of blood cultures were made in the same manner as in the control group with the exception of the media. The only difference was that 0.1 per cent para-aminobenzoic acid[28] was added to the medium for some of the cultures, to prevent the bacteriostatic effect of the sulfathiazole. The first and third blood cultures were made only in the medium containing p-aminobenzoic acid, while the second sample, about 12 cc. of blood (taken immediately after completion of the operation), was divided into two portions. Six cubic centimeters of the blood was added to approximately 70 cc. of a medium containing p-aminobenzoic acid, and the remainder added to approximately 70 c.c. of the same medium containing no p-aminobenzoic acid. The last procedure was carried out to determine the bacteriostatic effect of the sulfathiazole.

Enough blood was obtained in the first specimen to determine the blood level of sulfathiazole according to the method of Bratton and Marshall.[29] Twenty-three patients had blood levels of less than 3 mg. per hundred cubic centimeters and are being considered in a separate group. In this group, no positive cultures were obtained before operation or ten minutes after operation. Six cultures were positive immediately after operation. In three cases, the organism recovered was *Streptococcus viridans*. The actinomyces was recovered once, and *Staphylococcus aureus* and a spore-former were recovered once. If we disregard the spore-former (a contamination), the percentage of positive cultures was 17.3.

In fifty cases in which the sulfathiazole blood level ranged from 3.0 to 5.6 mg. per hundred cubic centimeters, two positive blood cultures were

obtained immediately after operation. The other blood cultures in the series were negative. *Streptococcus viridans* was isolated once, in both types of medium. *Streptococcus hemolyticus* was isolated once, and then only in the medium containing p-amino benzoic acid. Only 4 per cent were positive in the sulfathiazole-treated group, as compared with 12.8 per cent in the control group.

COMMENTS

In ninety-seven untreated cases, we found an incidence of positive blood cultures following the extraction of teeth of about 13 per cent. We have not included in this report positive culture reactions possibly due to contamination.

According to Richards,[2] O'Kell[7] and Murray,[9] the mere presence of gingival sepsis may offer a potential focus, which, under ideal circumstances, may at any time permit the invasion of micro-organisms, usually *Streptococcus viridans,* into the blood stream. Since subacute bacterial endocarditis is thought to be due usually to the localization of *Streptococcus viridans* on heart valves of persons with preexisting valvular lesions, transient bacteremia following oral surgical procedures is an important etiologic factor in this disease.

As a result of previous investigation, these facts were well recognized when this study was undertaken. However, at that time, no reports had been made as to the effect of the prophylactic use of the sulfa drugs on bacteremia of this type.

A series of cases in which sulfathiazole was given before the extraction of teeth were studied by means of blood cultures, but it is plausible that any of the sulfa drugs might have been as effective.

Although the number of cases treated by sulfathiazole premedication is smaller than that of the control group, it is felt that the results are significant. (A continuation of this study is planned.) In the group in which the blood level sulfathiazole was below 3 mg. per hundred cubic centimeters following surgical operations, positive blood cultures were obtained in 17.3 per cent of the cases, or about the same as in the control series. In the series of cases (fifty) in which the sulfathiazole blood levels reached 3 mg. per hundred cubic centimeters or more, there was a striking decrease in incidence of the positive cultures following surgical operations (4 per cent). In these two groups receiving sulfathiazole, two facts were observed: First, there was a marked individual response in the absorption and excretion of the drug as shown by the great variation of blood levels in people given the same amount of sulfathiazole. Secondly, in order to obtain optimum effectiveness of the drug, one should be sure that the blood level of the drug is above 3 mg. per hundred cubic centimeters and preferably between 4 and 5 mg. per hundred cubic centimeters. In the entire study of blood cultures in both the control and the premedicated series (173), no positive cultures were

obtained either before or ten minutes after surgical procedures. Therefore, one need only be concerned with obtaining a sufficiently high blood level of the sulfonamide at the time a surgical operation is performed. This can be done by giving a sufficient amount of the drug and keeping the fluid intake down during the twenty-four hours preceding the operation. We are attempting at the present time to raise the sulfathiazole level by giving one massive dose of the sulfonamide only a short time before the operation. Although the toxic reactions to the drug are directly proportionate to the size of the dose, it is usually thought that complications are more apt to occur when the drug is administered over longer periods.

The results of this study indicate that in patients with valvular disease, the possibility of an ensuing subacute bacterial endocarditis is greatly diminished by premedication with sulfathiazole. If this fact is accepted, immediately a new responsibility arises for the dentist as well as the physician.

The dentist's responsibility is to inquire routinely into the patient's past history, to determine whether the patient has ever had rheumatic fever or chorea, or there is any cardiac disturbance present. This should be done in all patients with severe oral sepsis or when surgical procedures are contemplated, for usually the patient will not furnish this information. If, from this inquiry, possible or definite information suggesting valvular disease is obtained, the dentist should contact the patient's physician, since the latter should administer the drug.

Usually, sulfathiazole can, except for nausea or dizziness, be given with safety. However, on rare occasions, the toxic manifestations may be severe after only a few doses.

The medical profession likewise has a responsibility in the management of the patient with symptoms of definite valvular heart disease. Once a physician has under his care a patient with rheumatic fever or chorea, terminating with or without valvular lesions, he should definitely inform the patient of the need of prophylactic treatment should a surgical operation become necessary.

SUMMARY

In a series of ninety-seven cases of minor oral surgical operation studied, in which blood cultures were taken before, immediately after and again ten minutes after operative procedures, the results were as follows: All cultures were negative before and ten minutes after operation, while, in the culture taken immediately after operation, 13 per cent were positive.

Streptococcus viridans and the anhemolytic streptococcus were the organisms usually isolated.

A study of seventy-three cases has been made showing the relationship of the prophylactic use of sulfathiazole to the incidence of transient bacteremia following the extraction of teeth.

This study indicated that when the blood level of sulfathiazole was below

3 mg. per hundred cubic centimeters, the incidence of bacteremia in twenty-three cases was found to be 17.3 per cent.

In a series of fifty patients in whom the blood level of sulfathiazole was from 3 to 5.6 mg. per hundred cubic centimeters, the incidence of bacteremia was 4 per cent.

This decrease in the incidence of bacteremia is thought to be significant and immediately places a new responsibility on the dental and the medical profession.

In order to provide maximum safety to this type of patient, it is desirable to establish the proper blood level of sulfonamide at the time an operation is performed. However, it is thought unnecessary to give premedication and postmedication for a considerable period of time.

BIBLIOGRAPHY

1. RICHARDS, J. H.: Bacteriologic Studies on Chronic Arthritis and Chorea. *J. Bact.*, 5:511, September 1920.

2. *Idem.*: Bacteremia Following Irritation of Foci of Infection. *J.A.M.A.*, 99:1496-1497, October 29, 1932.

3. BUTLER, H. M.: Blood Cultures and Their Significance. London: J. and A. Churchill, Ltd., 1937, p. 341.

4. SCOTT, W. W.: Blood Stream Infection in Urology. *J. Urol.*, 21:527-566, May 1929.

5. BARRINGTON, F. J. F., and WRIGHT, H. D.: Bacteremia Following Operations on Urethra. *J. Path. & Bact.*, 33:871-888, October 1930.

6. ELLIOTT, S. D.: Bacteremia Following Tonsillectomy. *Lancet*, 2:589-592, September 9, 1939.

7. O'KELL, C. C., and ELLIOT, S. D.: Bacteremia and Oral Sepsis. *Lancet*, 2:869, October 19, 1935.

8. ELLIOT, S. D.: Bacteremia and Oral Sepsis. *Proc. Roy. Soc. Med.*, 32:747-754, May 1939.

9. MURRAY, M., and MOOSNICK, F.: Incidence of Bacteremia in Patients with Dental Disease. *J. Lab. & Clin. Med.*, 26:801-802, February 1941.

10. BURKET, L. W., and BURN, C. G.: Bacteremia Following Dental Extraction. *J. D. Res.*, 16:521-530, December 1937.

11. HOPKINS, J. A.: Streptococcus Viridans: Bacteremia Following Extraction of Teeth. *J.A.D.A.*, 26:2002-2008, December 1939.

12. FISH, E. W., and MACLEAN, I.: Distribution of Oral Streptococci in Tissues. *Brit. D. J.*, 61:336-362, September 1936.

13. LICHTMAN, S. S., and BIERMAN, W.: Treatment of Subacute Bacterial Endocarditis. *J.A.M.A.*, 116:286-289, January 25, 1941.

14. SCHWARTZ, S. P., and SALMAN, IRVING: Effects of Oral Surgery on Course of Patients with Diseases of Heart. *Am. J. Orthodontics*, 28:331-345, June 1942.

15. HADFIELD, G., and GARROD, L. P.: Recent Advances in Pathology. Philadelphia: P. Blakiston's Son & Co., 1938, p. 392.

16. BARTELS, H. A.: Review of Recent Literature Dealing with Transient Bacteremias. *Am. J. Orthodontics*, 26:366-373, April 1940.

17. RUSHTON, M. A.: Subacute Bacterial Endocarditis Following Extraction of Teeth. *Guy's Hosp. Rep.*, 80:39-44, January 1930.

18. FELDMAN, J. M., and TRACE, J. M.: Subacute Bacterial Endocarditis Following Removal of Teeth or Tonsils. *Ann. Int. Med.*, 11:2124-2132, June 1938.

19. BERNSTEIN, MITCHELL: Subacute Bacterial Endocarditis Following Extraction. *Ann. Int. Med.*, 5:1135-1144, March 1932.

20. WEISE, H.: Relation of Portals of Entry to Subacute Bacterial Endocarditis Following Extraction of Teeth. *Arch. Int. Med.*, 54:710-719, November 1934.

21. SALE, LLEWELLYN: Some Tragic Results Following Extraction of Teeth. *J.A.D.A.* 26:1647-1651, October 1939.

22. EMMONS, C. W.: Strains of Actinomyces Bovis Isolated from Tonsils. *Puerto Rico J. Pub. Health*, 11:720-727, June 1936.

23. LORD, F. T., and TREVETT, L. D.: Recovery of Actinomyces-Like Organisms from Normal Mouth. *J. Infect. Dis.*, 58:115-120, January-February 1936.

24. CROWLEY, MARY C.: Isolation of Actinomyces-Like Organisms from Root Canals. *J. D. Res.*, 20:189-194, June 1941.

25. SLACK, JOHN: Source of Infection in Actinomyces. *J. Bact.*, 43:193-209, February 1942.

26. HOPKINS, J. A.: Unpublished data.

27. BUDNITZ, EDWARD; NIZEL, ABRAHAM, and BERG, LEO: Prophylactic Use of Sulfapyridine in Patients Susceptible to Subacute Bacterial Endocarditis Following Surgical Procedures. *J.A.D.A.*, 29:346-349, March 1942.

28. JANEWAY, C. A.: Methods for Obtaining Rapid Bacterial Growth in Cultures from Patients Under Treatment with Sulfonamides. *J.A.M.A.*, 116:941-942, March 8, 1941.

29. BRATTON, A. C., and MARSHALL, E. K.: New Coupling Component for Sulfanilamide Determination. *J. Biol. Chem.*, 128:537-550, May 1939.

Surgical Diseases of the Mouth.—Although, of course, various operations in connection with the mouth and its neighboring parts had been performed by general surgeons and dentists for centuries, yet it was not until the latter part of the 18th century that anybody conceived of oral surgery as a distinct specialty. In 1778, Jourdain published his work on *The Surgical Diseases of the Mouth.* The study of oral diseases, both in his own practice and in the writings of ancient and contemporary surgeons was his life work. It was Jourdain's conviction that the field of surgery had become so extensive that no one person, however learned, should attempt to deal with the whole field; and for this reason, he felt that oral surgery as a specialty was justified. On the other hand, he considered that the work in this field done by dentists, even the most distinguished (such as Fauchard) was not adequate and not undertaken with a sufficiently broad surgical view. Jourdain's work, which appeared in two volumes, was organized in the rather unusual way of dealing in one volume with the diseases of the upper jaw, and in the other with those of the lower jaw. In spite of this peculiarity, it covered rather systematically a large part of what today constitutes the field of oral surgery and furnished innumerable cases of the various diseases discussed. Eighteen chapters are devoted to conditions of the maxillary sinus. Among the subjects treated are the various tumors, cleft palates, caries and necrosis of the bone, abscesses, diseases of the salivary ducts, diseases of the gums, ranula, calculi, and hemorrhages.—Lectures on the History of Dentistry, Denton.

TREATMENT OF EXTENSIVE LOSS OF THE MANDIBLE AND ITS SURROUNDING TISSUES

VARAZTAD H. KAZANJIAN, M.D., Boston, Mass.

IN civilian practice, one rarely sees an injury to the lower jaw in which there is a complete loss of most of the mandible plus the surrounding soft tissues about the chin, including the lower lip and sublingual tissues. Such a wound is usually due to a shotgun injury. (Fig. 1.) In war times, these injuries are less common than one would imagine. They require special, individualized treatment from the beginning. The care of these cases will be considered in three parts, each being a step in the program which must be completed before the next is taken: (1) the early period of treating the wound and preserving the patient's life; (2) the preservation of the remaining part of the mandible, and the reestablishment of mandibular functions, and (3) the restoration of the lower lip and the chin. It is only through the complete understanding and execution of each of these steps that one is able to prevent the patient from becoming a social outcast.

EARLY TREATMENT

Early treatment consists essentially of first-aid and competent nursing, and often drastic measures must be employed to save the patient's life. If hemorrhage occurs, it is of short duration, because most of the arteries severed are terminal, and control themselves quite readily. Of course, any continuous arterial pumping has to be stopped by pressure or the use of hemostats. The wound is wide open and there is little chance for deep bleeding, all vessels being near the surface. Secondary hemorrhage is fairly rare, and it can be readily controlled as primary bleeding would be, by the use of hemostats and ligation. In the majority of these cases, the patient is in a state of shock, which is treated by the accepted procedures.

Today, with the advent of chemotherapy of wounds, sepsis, which was invariably present during the last war, may be greatly reduced and frequently prevented; but if not prevented, it may be controlled in considerable degree in the majority of cases. The procedure of accepted choice today is a thorough, complete cleansing of the wound by irrigation and débridement. General anesthesia at this stage should be avoided because the patient's inability to control the tongue invites respiratory obstruction and asphyxia. A local anesthetic should be employed if possible.

Asphyxia, mentioned as a danger in general anesthesia, may be present

From the Plastic Clinic of the Massachusetts Eye and Ear Infirmary, the Massachusetts General Hospital and the Harvard Dental School.

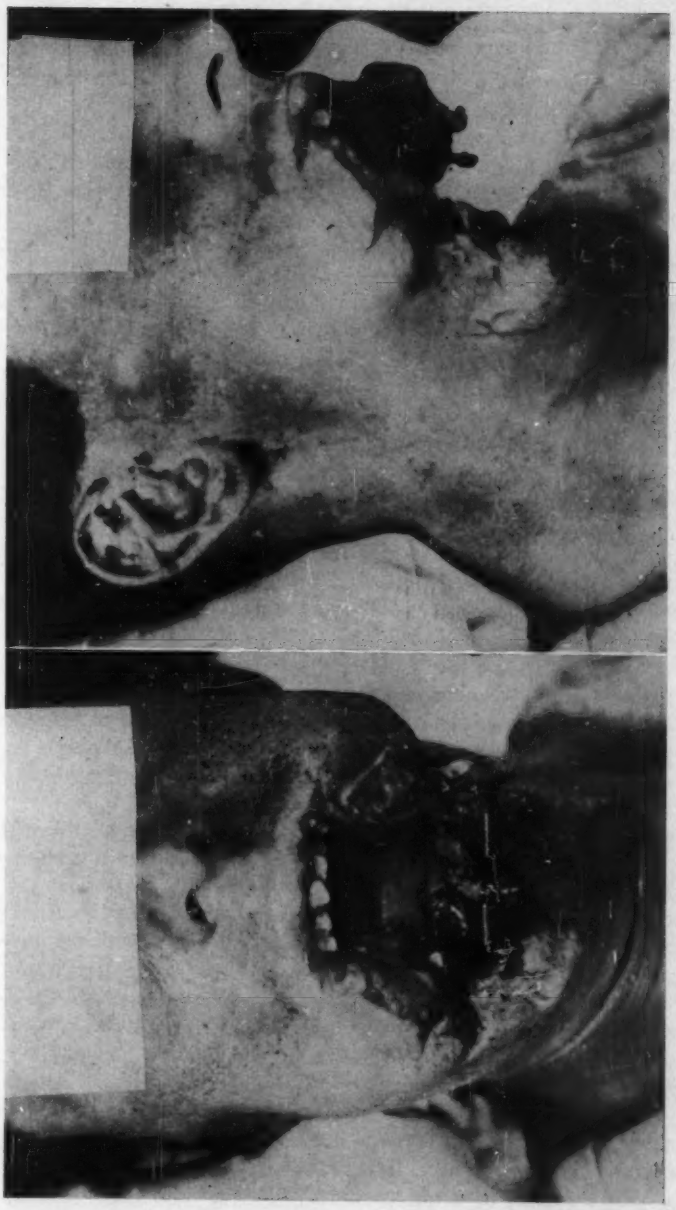

Fig. 1.—Typical injury; showing loss of the greater part of mandible, soft tissues about lip and sublingual tissues.

from the onset, for, with loss of the mandible, the forward muscular attachments and the hyoid are gone, so that the tongue tends to fall back into the hypopharynx. Coupled with this condition are the usual swelling and edema that accompany severe trauma, and the two together tend to close off the glottis. To prevent the tongue from falling back, with resultant obstruction, several simple procedures can be used in first-aid. First, the patient may lie on his stomach with his face turned to one side. In this way, gravity tends to pull the tongue forward. If this fails, a safetypin or suture can be inserted through the tip of the tongue so that constant traction is exerted. The utilization of an artificial airway similar to one used in general anesthesia is also possible. If these simple procedures fail, it may become necessary to perform an emergency tracheotomy, whereupon the edema and the position of the tongue can be temporarily ignored.

Owing to this lack of function of the tongue, patients are liable to have difficulty in swallowing, and food and saliva collect in what is left of the oral cavity. If the patient is not kept in a position to encourage drainage away from the hypopharynx, there is aspiration, with resultant inhalation and the possibility of bronchopneumonia. The patient must be well nourished, and since he cannot chew at all and can swallow in only a restricted fashion, he must be fed by other means. In the early stages, it is usually advisable to administer liquids intravenously. As early as possible, feeding can be carried out by means of nasal or esophageal tubes. The nasal tube of small caliber is usually the most comfortable one, and least difficult for the patient to tolerate. As a matter of fact, this tube can be left in place for several days without causing any ulceration or soreness along its path. It is preferable, however, to leave it in for short periods, and patients adapt themselves to this awkward method of nourishment, within forty-eight hours, with amazing ease. Any concentrated liquid of high caloric value can be administered in this way.

Occasionally, the nasal tube cannot be used because of some obstruction, and a larger tube must be passed through the mouth. This is not so comfortable for the patient and must be removed after each feeding. If the patient appears to be inadequately fed, the attending surgeon is justified in resorting to gastrostomy. During the last war, all of our patients were fed by the tube methods.

Apart from the control of hemorrhage, surgical interference in the early stages will be limited to the removal of dirt, loose fragments of bone, teeth and devitalized shreds of soft tissue. A little later, when active infection is under control and the edema and swelling begin to subside, a judicious amount of early suturing can be done. This consists of suturing wounds radiating from the main wound, as well as the vital but misplaced skin and mucous membrane in and about the mouth.

The wounds, being open, drain readily. The majority of patients have a

slight elevation of temperature and pulse rate. Fever may be due to lung complications or an abscess developing in the deeper tissues, from the presence of foreign bodies such as splinters or fragments of teeth or bone that have been forced into the surrounding tissues and have not been detected, or from other injuries. In such complications, a local reaction of tissues in the form of swelling and tenderness, combined with x-ray findings, will establish the diagnosis. One may also suspect other conditions and diseases when there is no local indication to justify the elevated temperature. Adequate measures should be taken to combat these complications.

Once this phase of early treatment is carried out successfully and the patient is on the road to recovery, future restorative treatment must be planned. It is necessary to (1) restore the power of mastication; (2) improve the facial appearance as much as possible, and (3) prepare the field for future plastic operations, including a probable bone graft.

RESTORATION OF MANDIBULAR FUNCTION

There are two distinct factors in the restoration of mandibular function: (1) preservation and control of the surviving portions of the mandible and (2) an artificial restoration that will afford a framework for the cheeks, lips and chin.

Experience has shown that loss of a part of the mandibular arch does not mean a total loss of masticatory power. We know that the isolated parts have a certain degree of masticating power when properly utilized. Their usefulness will depend on the amount of pressure that they can endure.

From the cases that I treated during the last war and have treated in civilian practice, no matter how extensive the external wounds appear, there always exists bony tissue of the mandible capable of serving as a foundation for future reconstruction. This may include a part of the body of the mandible on each side, with or without teeth, or may consist of only two exposed stumps of the ascending rami.

The utilization of the remaining parts of the mandible is the first essential step in reconstruction of the face and jaw of the victim. Unless these bony segments are carefully conserved at the earliest possible moment, irremediable displacement will ensue and will complicate future plastic procedures. The position that the surviving fragments of bone will assume if the case is neglected will vary according to the length of the remaining mandibular segments. If the fracture is at the angle of the jaw, the ramus will be drawn upward and outward and, if unrestrained, will become lost in the tissues of the cheek. If the bony stump is farther forward, in the bicuspid region for example, the chief displacement may be either inward or upward toward the zygomatic fossa.

As soon as local conditions are sufficiently favorable (usually from eight to ten days after the injury), temporary splints should be adjusted to hold

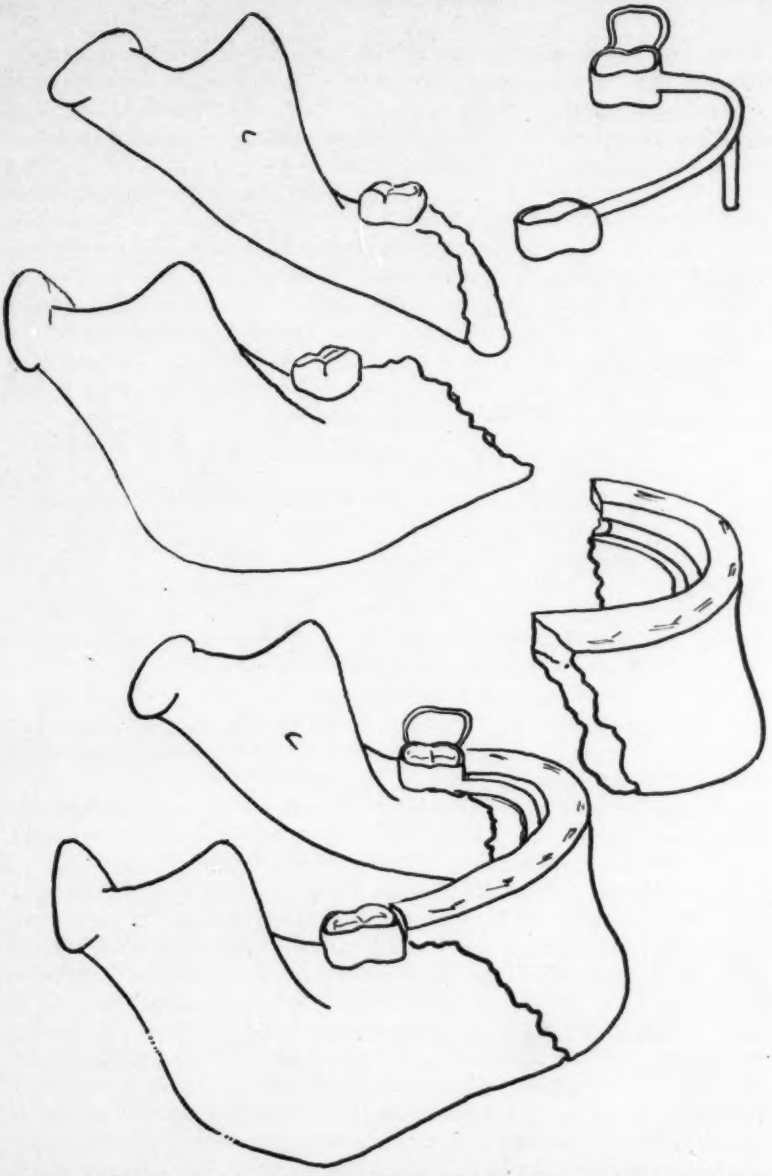

Fig. 2.—Diagram showing teeth on both mandibular stumps. A splint consisting of metal bands connected by a stout wire is quickly made and fastened in position before the stumps become displaced by muscle pull. A removable splint made of plastic material fits over the arch and acts as a substitute for the missing bone. This splint is a necessary support of the soft tissues when the plastic operation is performed for reconstruction of the lip and chin.

the remaining portion of the mandible in position. At this stage, the fragments of bone are still loose and are therefore easily manipulated. If treatment is postponed, the gradual pull and shortening of the masseter and pterygoid muscles will cause the difficulties explained above.

CONSTRUCTION OF SPLINTS

After experimenting with various methods, two types of splints were found to be simple and efficient. The choice depends on the nature of the case and on the teeth present.

1. If there are teeth on both sides of the jaw, the third molars for example,

Fig. 3.—Temporary splint that can be quickly made when no teeth are available by bending metal plate (german silver 24 A.G.) to a U shape. Modeling compound is added and an impression of the remaining alveolar ridges taken. The splint is reproduced in vulcanite or plastic material. This appliance is simple and effective and its springiness facilitates adjustment and retention.

a heavy band-and-bar splint is made. (Fig. 2.) The bands are like strong orthodontic bands, and the bar is much like a lingual bar, passing around at the imaginary cervicolingual margin of the incisors, with a small T at the median line. A removable vulcanite splint fits over this arch.

2. If no teeth are available, a metal plate (german silver 24 A.G.) is bent to a U shape (Fig. 3), modeling compound is added and the impression of

the remaining alveolar ridges is taken. The same compound bears the imprint of the opposing teeth. Thus, there is lateral and vertical control of the mandibular segments. The splint is removed from the mouth, trimmed, corrected and smoothed, and is then reproduced in vulcanite or in plastic material. This appliance is simple and effective, and its springiness facilitates adjustment and retention. Almost no alterations are made until the wound is ready for a plastic operation.

At all times, it is important to insure a buccal furrow between the cheek and the remaining portions of the alveolar process of the mandible; for if this groove has been obliterated, it is difficult to secure function and stability

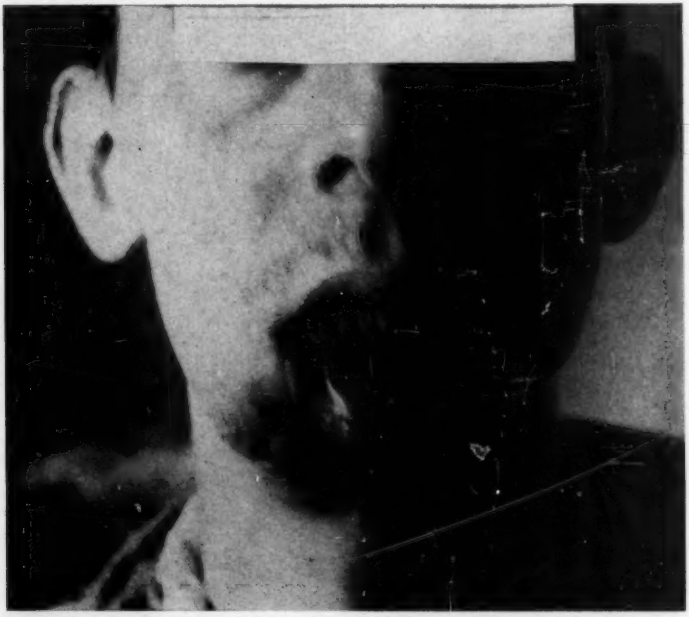

Fig. 4.—Later photograph of patient shown in Figure 1 (Case 1). Infection about the wound has disappeared and the tissues have assumed this characteristic picture.

in the prosthetic appliance. To avoid this drawback, flanges are added to the temporary splint to prevent the disappearance of the furrow during the process of healing. It may happen that the alveolar process has been destroyed and that the groove cannot be traced. Here, the mucous membrane is incised along its attachment to the ridge, a deep cut is made in the soft tissues along the margin of the jaw and mattress sutures are inserted in the cut surface of the mucous membrane, passed through the bottom of the

groove to the skin surface and tied over buttons. In another procedure, the stump, if free from infection, may be dissected freely over the periosteum and covered with a skin graft. But a groove, or even a pocket, must be maintained or be created.

PROSTHETIC RESTORATION

Before operation on the lip and chin, it is necessary to construct a prosthetic appliance, to which the patient becomes accustomed. It has the following features:

1. It is held in place by the remaining teeth, by the alveolar ridges or by the upper teeth in occlusion.
2. Its bulk represents the lost bony tissue, especially at the symphysis.
3. It is made in three sections to facilitate removal, cleaning and readjustment in the mouth. (Figs. 4 and 5.)

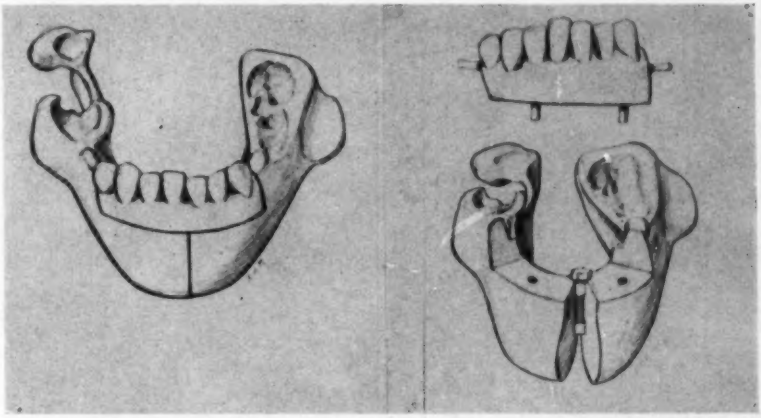

Fig. 5.—Diagram of appliance used as substitute for missing portion of mandible. It is hinged at the middle to allow for its collapse and introduction into the mouth. When spread to position, it is locked by a vulcanite section carrying the teeth. Figure 4 shows the appliance in place, and it should be worn prior to operation for reconstruction of the lip and chin.

After plastic operations have been completed and the tissues have assumed a definite form, a new appliance or denture is made to meet the conditions. In the event of massive destruction of the lower part of the face, one must not be too optimistic, or expect to duplicate the former contour of the face. If the surgeon can create a lower jaw resembling a chin, the patient may walk among his fellowmen with confidence. If, in addition, he now retains saliva, holds and masticates food fairly well, drinks from a cup and talks clearly, both surgeon and patient will feel compensated for a long and tedious undertaking.

UMI

The next problem is that of obtaining sufficient skin and mucous membrane with accompanying soft tissue to close the wounds and to cover the appliance. The epithelial lining of the buccal surface must be as extensive as the area of skin to be borrowed for the exterior. If possible, the lip should contain muscular tissue as well as the visible membrane.

When we examine the literature of the last war, we find a number of articles in which this subject has been discussed. Pickerill relied mostly on the double tubed flap to obtain enough tissue for the lip and chin. One tubed flap was obtained from the skin covering the entire length of the sternomas-

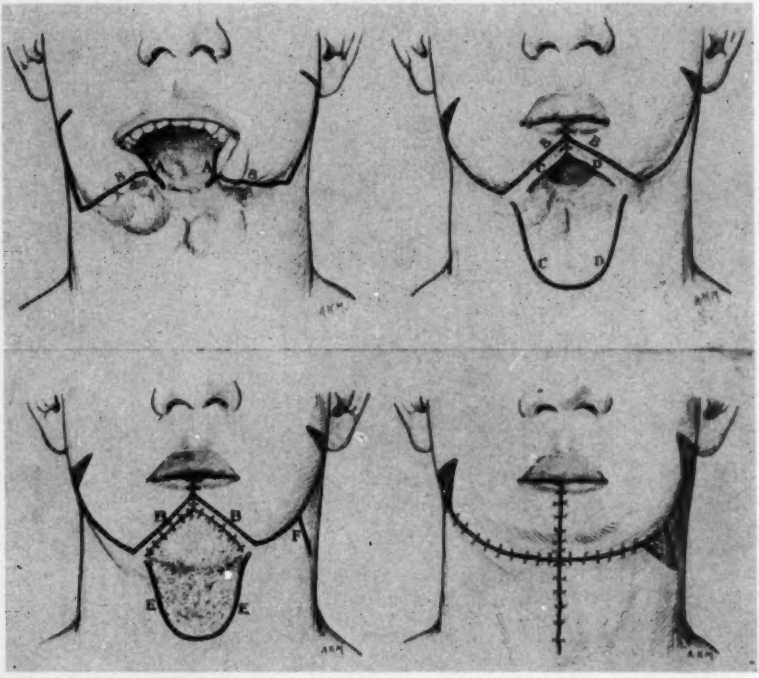

Fig. 6.—Above, diagram showing utilization of two large flaps from remaining parts of lip, cheek and side of neck. Below, a flap of skin turned up from front of neck, to obtain epithelial lining for buccal surface. This is only practical when the skin of the neck is not hair-bearing.

toid muscle, while another long scalp flap from the zygoma to the vertex was cut, tubed in at its lowe. part and swung downward to cover the previously placed neck flap. It was then sutured around the margins. Later, this flap, partly from the hair-bearing area of the scalp and partly from the non-hairy part of the neck, was carried to the lower part of the face so that the neck

flap formed the inner lining while the scalp area of the flap formed the outer surface.

Dufourmentel utilized the skin surrounding the defect to form the inner surface of the mouth, and large double pedicled flaps from the scalp to

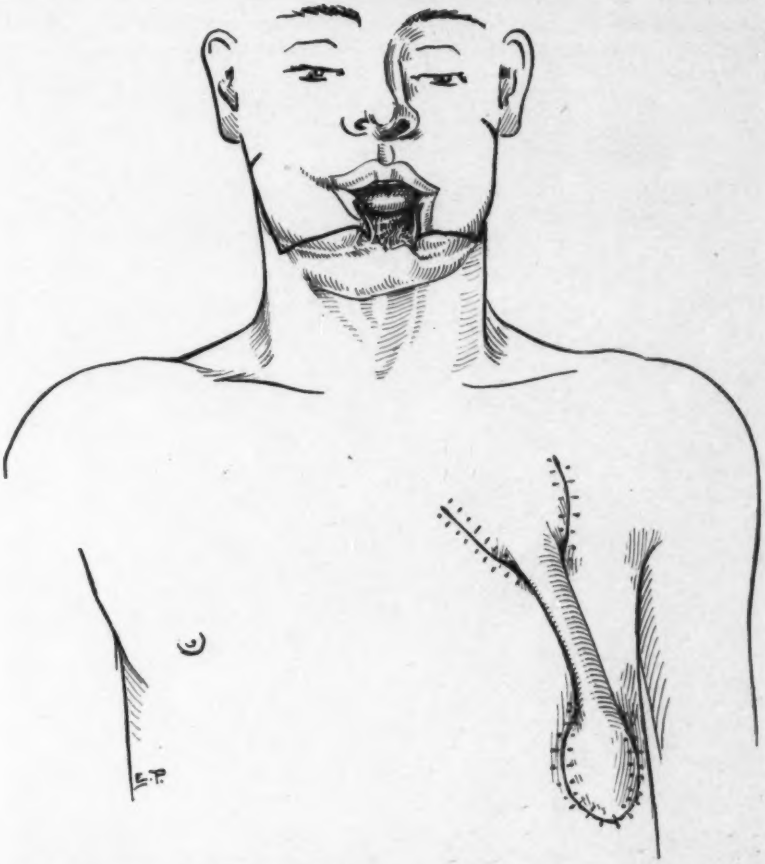

Fig. 7.—Measured, delayed flap prepared from non-hairy area on upper part of chest, when neck flap cannot be used to supply epithelial lining of mouth, because of presence of hair. The tube section of the flap acts as a carrier.

cover the outer surfaces. Various authors used similar methods with modifications.

In our series of cases, we have adopted an entirely different approach. As previously mentioned, we have emphasized the importance of preserving

and placing the mandibular stumps and in having them support an appliance. Plastic operation is postponed until the condition of the tissues is favorable, and until the appliance has been given a trial. In all our cases, we were able to swing two large flaps from the remaining parts of the lip, cheek and side of the neck, as shown in Figure 6, above. These flaps have the advantage of including muscular tissue from the orbicularis oris. Occasionally, they have less elasticity because of the presence of scar tissue.

Fig. 8.—Final photograph of patient (Case 1) previously shown in Figures 1 and 4.

After they have been brought over the appliance, any extra tension can be relieved by shallow crisscross incisions in the skin, which are made with a scalpel.

The provision of a complete epithelial lining for the buccal surface was a more difficult problem. There was usually enough mucous membrane to

line the upper part of the lip, but to provide for the deep pouch in which the denture was to lie, a flap of skin was turned up from the neck. (Fig. 6, below.) This method provided sufficient skin for the inner lining, but it was soon realized that if the neck flap was taken from the hair-bearing area, the growth of hair within the mouth would be an objection. To remedy this, two weeks before the major operation, a measured delayed flap was prepared from the non-hairy area of the chest, the upper part of which was tubed to act as a carrier. (Fig. 7.) This method proved highly satisfactory, for, in addition to providing non-hairy skin, the tube flap could be used to advantage if additional tissue was required.

Fig. 9.—Photograph of patient (Case 2) (Dec. 12, 1940) showing extensive destruction of body of mandible and loss of lip and chin approximately two months after injury. A good deal of infection is present and the mandibular stumps are extensively displaced.

The foregoing procedure should be considered as semifinal, preceding the reestablishment of the bony continuity of the mandible by bone grafting. Fortunately, our present-day technic for the transplantation of bone has progressed far enough to make this final step practicable. However, it cannot succeed unless the recipient area and the tissues surrounding the skin are vascular and free from dense scars. If, in certain cases, bone grafting is for some reason not advisable, it is gratifying to know that these patients

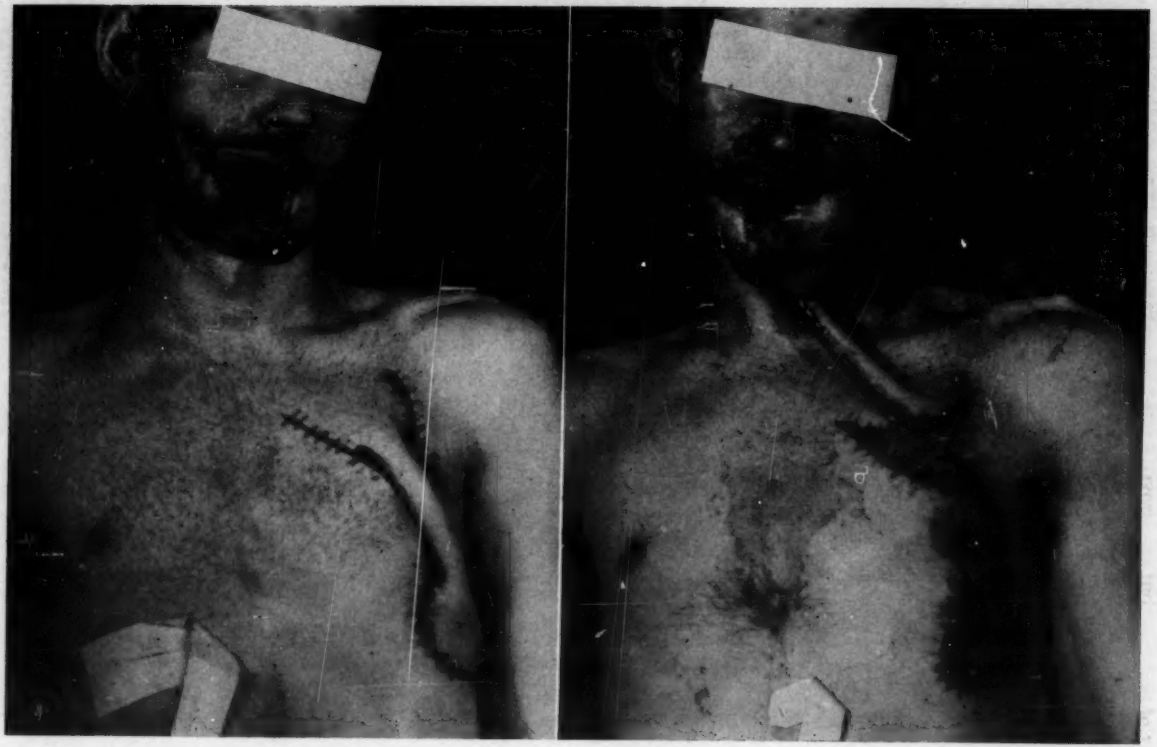

Fig. 10.—Left, photograph of patient (Case 2) (Feb. 21, 1941) two months after admission to hospital. Most of the infection about the mouth has disappeared. Preparation of the chest flap is shown. Right, chest flap removed from its bed and swung up to form inner lining of mouth.

are able to masticate food tolerably well on the remaining stumps of the mandible.

The operative and prosthetic procedures outlined are perhaps oversimplified for the sake of clarity. Actually, each case presents its own problem, which must be handled individually. The presence of long-standing infection, radiating scars, elasticity of individual tissues and many other conditions may create new problems and make it necessary to perform further operations in order to obtain better results. The fundamental points that I wish to emphasize are:

1. The preservation of the surviving parts of the mandible in a useful position.

2. The substitution of lost bony tissue by prosthetic appliances before reconstruction of the chin.

3. The use of soft tissue flaps, outlined in this paper as an important step toward restoration of the contour of the lower part of the face.

I am making free reference to a paper published in 1918.[3] Case 1 from this paper was so completely documented and illustrated, and so typical a case in all respects, that it seemed justifiable to again use it, especially since the technic is basically unaltered after a lapse of a quarter of a century.

REPORT OF CASES

CASE 1.—*History.*—F. N., wounded August 21, 1916, and admitted to hospital August 23, had suffered a large shell wound of the chin with extensive loss of soft tissues. The lower lip was lacerated. The body of the mandible was missing from the right bicuspid region to the left third molar, only one molar (right) remaining in the lower jaw. (Fig. 1.) Various minor operations were performed under procaine for removal of sequestra, extraction of roots from the upper jaw and partial suturing of the borders of the wound. Temporary retention splints were applied.

Treatment.—February 2, 1917, an appliance made for the patient to wear preparatory to plastic operation on the soft tissues was composed of a hinged plate of suitable size and bulk which rested upon remaining portions of the alveolar ridges of the lower jaw, the occluding surfaces in the molar regions receiving the cusps of the upper teeth, which helped to retain the plate in position, while a second plate interlocked and held the apparatus together. (Figs. 4 and 5.)

February 13, plastic closure of the wound was carried out under procaine, with cheek flaps as seen in Figure 6, and the lip edges and mucous membrane were joined until tension forbade further suturing. This left a gap through which the artificial chin (not shown in the illustration) projected. The gap was closed by turning up a triangular flap of skin from the neck and suturing this to the edges of the mucous membrane, with the epithelial surface inward so that it lay in contact with the vulcanite appliance. Fortunately, the neck flap which made the inner surface of the mouth did not contain any hair. The cheek flaps were then brought together over this and united along the

median line, and the raw surface of the anterior surface of the neck was closed by drawing together the skin of the neck, which is plentiful in this region. Tension when they were stretched over the artificial mental prominence rendered the cheek flaps white and bloodless. This tension was sufficiently relieved by crisscross incisions.

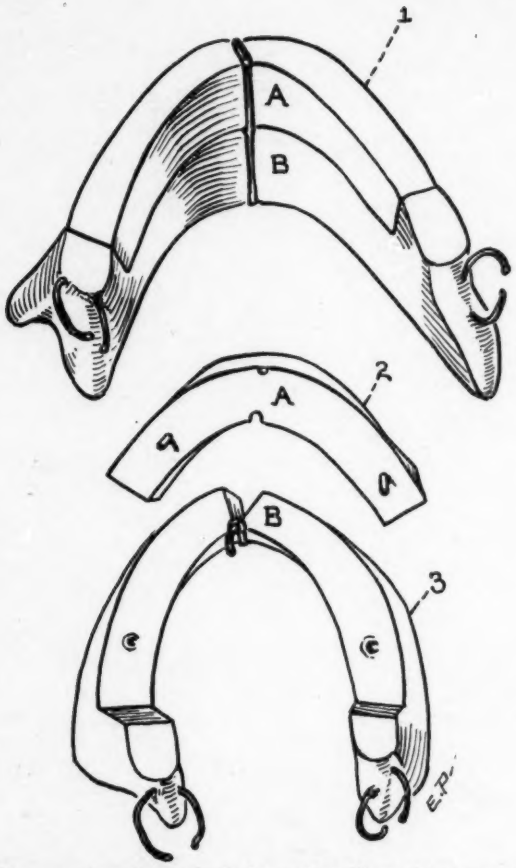

Fig. 11.—Diagram of appliance made for patient (Case 2) prior to operation. This appliance is also made in collapsible form in three sections and is retained in position by a clasp around the neck of the remaining tooth on each side of the mandible.

Outcome.—After the wound had firmly healed, the patient was supplied with a permanent appliance. The final condition of the patient is shown in Figure 8. The result was satisfactory as regards both function and appearance.

Fig. 12.—Final photograph of patient (Case 2) showing appearance at present time, with appliance in position. An operation for transplantation of bone is scheduled.

CASE 2.—*History.*—H. E. was accidentally wounded and received an extensive injury of the lower part of the face. He was treated at a local hospital for two months before being transferred to the Massachusetts General Hospital.

Examination on arrival revealed a badly infected wound with extensive loss of the lip, chin and tissues of the lower part of the face; also destruction of the greater part of the mandible. (Fig. 9.) There was a large heavy scar line on the right side of the face extending toward the ear. The right corner of the mouth was covered with dense scar and a section of mucous membrane tissue was healing in a contracted state around that corner of the mouth. A few fistulous tracts about the wound were discharging pus freely. There was considerable destruction of the anterior part of the mandible, and because no attempt had been made to control the remaining parts of the mandible, marked displacement had taken place. The right stump carrying one tooth was pressing against the palate, while the left one, approximately the same size, was displaced upward and outward toward the zygomatic fossa. They were anchored so high that it was not possible to displace them on digital pressure.

The patient's physical condition was fair. He had lost a great deal of weight and had considerable secondary anemia.

Treatment.—The first desire was naturally to control infection. Frequent dressings were applied and a few days after arrival the patient's general condition permitted the first operation, under intratracheal anesthesia, December 23, 1940. Several pieces of necrotic bone were removed through the various fistulous tracts, and a dense scar leading toward the angle of the mandible was excised and the wound sutured.

The mucous membrane that was curled around the corner of the mouth was separated from its base and sutured along the lower border of the wound with the intention of utilizing it later to form the mucous membrane of the lip. Finally, the displaced mandibular stumps were forcibly brought down and held in position against the lower teeth by wiring the remaining two molars of the lower jaw to the upper teeth. Great difficulty was experienced in controlling the stumps owing to the extreme pull of the shortened masseter and internal pterygoid muscles. However, the trismus gradually disappeared and the patient was able to move the segments of the lower jaw quite freely.

The second operation, January 14, 1941, consisted of preparing a delayed flap of skin on the left side of the chest. (Fig. 10, left.) It was necessary to select a hairless area farther down on the chest. The upper part of this delayed flap was tubed to act later as a carrier. In the meantime, a hinged type of denture was made by the members of the dental staff. (Fig. 11.) In the main operation, two large flaps on each side of the face were shifted forward to form the lip and chin. At the same time, the end of the tube flap was raised from its bed and turned forward to form the inner surface of the mouth, where the mucous membrane was lacking. (Figs. 7 and 10, right.)

Subsequent operations consisted mainly of detaching the tube freely from the chin, the unused part being put back in its original position, closing the floor of the mouth and improving the contour of the lip and chin.

Outcome.—The present condition of the patient is seen in Figure 12. He has full coordinated control of the mandibular stumps with the prosthetic

appliance in place. He wears the appliance constantly and is able to use it as he would an ordinary denture. At the present time, the patient is listed for a bone transplantation.

BIBLIOGRAPHY

1. PICKERILL, H. P.: Facial Surgery. New York: William Wood & Co.

2. DUFOURMENTEL, I.: Essai de Reconstitution Totale du Massif Maxillaire Inférieur par des Graffes Cutanees Muqueuses et Osseuses. La Restoration Maxillo Facialle. Vol. 3, 1919.

3. KAZANJIAN, V. H., and BURROWS, HAROLD: Treatment of Gunshot Wounds of Face Accompanied by Extensive Destruction of Lower Lip and Mandible. *Brit. J. Surg.*, 6:74, July 1918.

475 Commonwealth Avenue.

Difficulties of Location in Oral Surgical Disesases.—The various parts, which are the seat of these affections, often present difficulties to the surgeon, great and at the same time most instructive—instructive in the operations required, and in the consequences always resulting—in the treatment demanded and also in the medicines administered, having due reference to their nature and operation. The rules laid down for the general treatment of surgical diseases in other parts of the body, can be by no means equally and indiscriminately applied to those of the mouth. For instance, the difficulty of arresting certain hemorrhages, from the impossibility of applying effective and permanent compression; the fear lest certain corrosive applications should be dissolved by the saliva, pass into the oesophagus, and thence into the stomach; the position of certain parts requiring an operation; finally, the difficulty of retaining a dressing, and the diminished effect of medicines, weakened by solution in the saliva and other fluids of the mouth—all present so many obstacles to be overcome in the treatment of surgical diseases of the mouth, which are not to the same extent met with in other parts of the body. If, moreover, regard is had to the nature and structure of either of the maxillary bones, and their differing degrees of ossification, varying with the age and with the seat of the disease, no impartial man can fail to be convinced that, unless to a knowledge of general principles be added a special attention to this particular branch of surgery, there will be a liability to error in the operations and treatment required by these diseases.—Surgical Diseases of the Mouth, Jourdain, 1778.

FRACTURE OF THE MANDIBULAR CONDYLE

DON H. BELLINGER, D.D.S.; FREDERICK A. HENNY, D.D.S., and
LEROY W. PETERSON, D.D.S., Detroit, Mich.

THERE has been much discussion in the literature relative to the treatment of fractures of the mandibular condyle. Two schools of thought have existed, one advocating conservative treatment, the other, open reduction. Both have backed up their opinions with case histories, making it difficult for a neutral observer to properly assay the relative merits of each procedure. Because of this confusion, we have made a study of the last 100 cases of condylar fractures coming under our care, in an attempt to clarify the picture.

Four separate classifications have been used to better organize the study. These are as follows:

Class I (Fig. 1): The condyle remains within the glenoid fossa. Some overlapping of the fragments may be present; sixteen cases.

Class II (Fig. 2, left): The condyle is displaced, but some approximation of the fragments is present; fifty-seven cases.

Class III (Fig. 3, right): There is complete disarticulation of the condyle; twenty-five cases.

Class IV: The fracture lines involve the joint surfaces with comminution of the surrounding bone; two cases.

It is readily seen that the first three types are by far the most common, since they contain 98 per cent of our cases. All cases were treated conservatively and only two required surgical interference, those falling in Class IV, which will be described in detail later.

Since our classification is largely one of position, it is determined to a large extent by the muscle attachments, as well as the severity and direction of the trauma.

The only muscle attached to the condyle is the external pterygoid. If it is unopposed, the condyle will be drawn out of its normal position in a medial anterior direction until it is entirely out of contact with the ramus of the mandible. As noted above, this happened in one-quarter of our cases. Such factors as the direction of the fracture line, direction and amount of the original force and anatomic variations all play an influential part in determining the degree of displacement.

The facial musculature supporting and influencing the mandible consists of a double set of identical muscles acting as an anatomic unit, maintaining balance and stability and producing motion. It is to be expected, therefore,

---

From the Division of Oral and Maxillofacial Surgery, Henry Ford Hospital.

that any disturbance of this anatomic symmetry will interfere with the range of motion and interdental relationships. This would be a routine deformity if there were not an unusual ability for compensatory repair. Many fractures of this structure heal without any active treatment whatsoever. By the same token, perfect occlusion, perfect excursion and perfect function do not always follow. It may be said, however, that function has been adequate in each case of this series. Although the final function has not always been what could be desired, it has been sufficiently good to permit normal functioning movements of the mandible. In cases of imperfect functioning, the choice of surgical interference is always available, but it has never been resorted to by us for primary treatment.

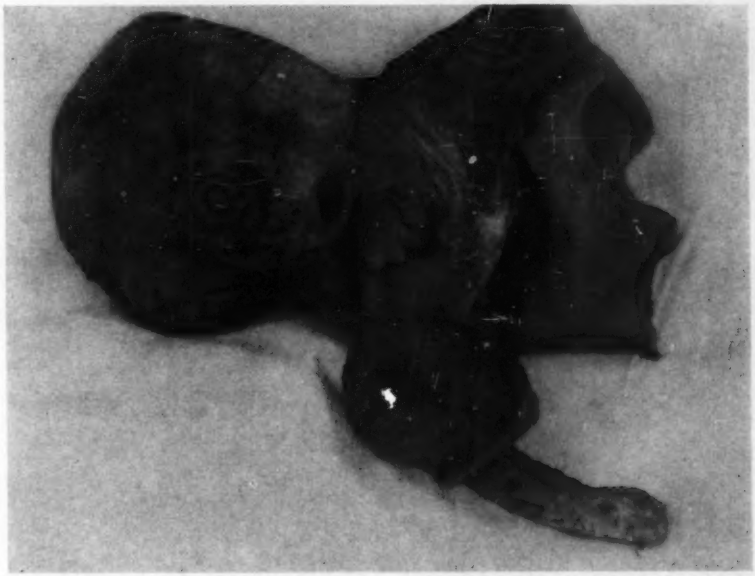

Fig. 1.—Type I. The zygomatic bone is removed to show the insertion of the temporal muscle over the coronoid process. The head of the condyle is pulled slightly medially and the ramus lifted and pulled medially, an overlapping of fragments resulting. The capsular ligament has also been dissected off to show the condylar head and intra-articular disk.

Clinical diagnosis is generally quite simple, but x-ray verification may be difficult. Crepitus, occlusal deformity, swelling and tenderness over the joint and loss of function generally combine to make a fairly definite clinical picture. Diagnostic roentgenograms can usually be obtained with a postero-anterior view, but it may be necessary to supplement this with a lateral jaw exposure or mastoid films to show the condyle. This combination will

ordinarily provide the necessary information regarding the direction of the fracture line, the displacement and the amount of fragmentation.

All of our cases were treated conservatively, and reduction was accomplished by either intermaxillary traction or interdental ligation. Surgical interference in the two cases falling in Class IV was undertaken only as complications developed. Ankylosis did not follow in any of the cases treated. The use of elastics is the method of choice, and interdental ligation is resorted to only when too few teeth are present to permit stabilization. The advantages of using rubber bands are many[1]: Reduction under local anesthesia is easy; excessive manipulation of the jaw, which is especially undesirable when other fractures are present, can be avoided, and the

Fig. 2.—Left: Type II. Displacement with impaction of fragments. The upper component of the pterygoid muscle is shown inserted in the interarticular disk. This type of displacement tends to impaction of fragments. Right: Type III. Complete dislocation. The head of the condyle is anterior to the articular eminence. The condyle is ruptured through the articular capsule.

elastics can be removed periodically for thorough cleansing of the oral cavity. Slight motion is permitted and the patient can soon subsist on a soft diet, which has its obvious benefits. For retention of the elastics, we use small aluminum shells which are easily and quickly wired to the teeth. Stout[2] has described a multiple loop form of wiring that offers greater stability and is especially beneficial when traction on the anterior teeth is

necessary, as is often the case. Arch bars with lugs attached can also be utilized.

In the first classification, we have sixteen cases, and but little elaboration of what has been noted above is needed. The resulting occlusal discrepancy is easily corrected and partial immobilization in this position is maintained with a minimal amount of elastic traction. Overlapping of the fragments is due to trismus of the elevator muscles occasioned by tissue edema associated with extraneous trauma. The internal pterygoid has a tendency to pull the ramus medially, while the condylar fragment is laterally posed owing to the action of the external pterygoid on the head and intra-articular disk. The end-result is usually a bony union, and the condyles can be easily pal-

Fig. 3.—Postero-anterior view, showing bilateral osteotomy for correction of mandibular prognathism. The condyles remained in the fossa and good bony union resulted.

pated during movements of the mandible. Rubber bands can be removed in from three to four weeks.

Figure 3 is a roentgenogram taken after a bilateral osteotomy for correction of mandibular prognathism. The entire lower jaw was moved backward and held in neutroclusion by rubber-band traction on a previously constructed orthodontic appliance. Final bony union resulted and both condyles functioned normally. Thus the case illustrates that extraneous trauma is a factor in the displacement of the superior fragment.[3]

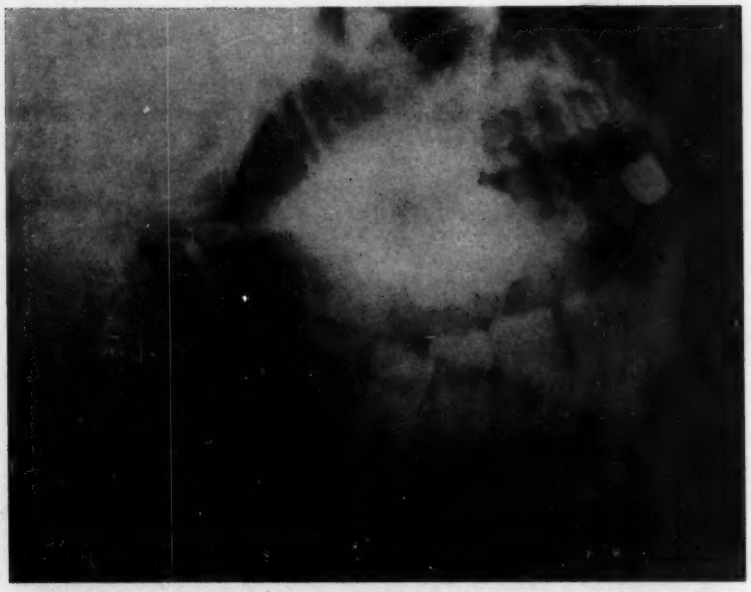

Fig. 4.—Preoperative roentgenogram taken in lateral jaw position. The condyle is displaced from the fossa and there is an overlapping of fragments.

Fig. 5.—Postoperative view of case in Figure 4, ten months later. These are regular mastoid films designed to show the temporomandibular joint. Original overlapping and displacement still exist.

Class II includes the majority of our cases, there being fifty-seven in the present summary. Displacement of the condyle usually occurs in an anterior medial direction owing to the pull of the two heads of the external pterygoid muscle. The lower part of the fragment is thus inclined laterally and posteriorly. The entire jaw deviates to the injured side as the muscle on the intact side loses its balancing opponents, pulling that side medially and forward. On the injured side, the internal pterygoid and masseter lose the bracing effect of the condylar head and have a tendency to elevate the mandible, causing an open bite in the anterior region, particularly if there is a loss of posterior teeth.

Figures 4, 5 and 6 are selected as typical of this type of fracture. Included are preoperative and postoperative roentgenograms of a bilateral fracture of the condyles complicated by a compound fracture at the symphysis. The patient also sustained extensive facial lacerations and a head

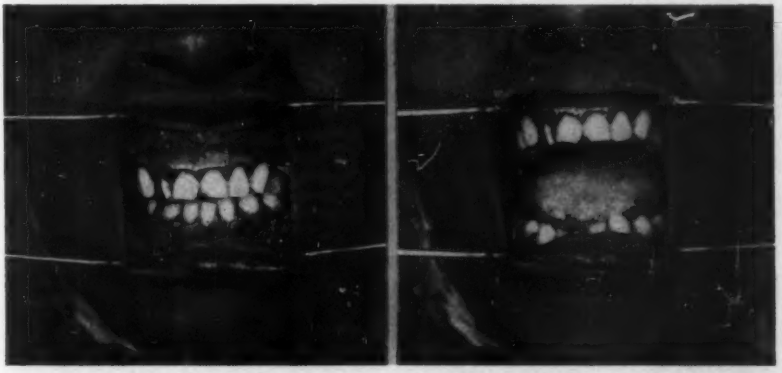

Fig. 6.—Left: Occlusal result, postoperative. Right: Amount of motion and opening. Lateral movements were also easily made.

injury. Reduction was not attempted until seven days after the accident, but the fragments were quickly brought into correct alinement by intermaxillary traction. The postoperative roentgenograms show the condylar heads still displaced, and clinically no movement could be detected when the jaw was opened and closed. Final photographs show a normal opening. Lateral excursions were easily made, and the occlusal relationship is ideal. In such cases, a flail joint results from proliferation of fibrous tissue and eburnation and rounding off of the bony stumps.

In one case, a good result was obtained after a delay of twelve weeks in instituting treatment. Because the patient had severe cranial injuries and fractures of the cervical vertebrae, nothing was done about the condylar fractures until recovery was assured. The typical occlusal deformity with a

UMI

wide opening in the anterior region was observed. Arch bars were ligated to the remaining teeth, and, with intermaxillary elastics, reduction was accomplished in forty-eight hours. After the necessary immobilization, mandibular function was excellent.

Ivy and Curtis[4] have suggested a method of decreasing the shortening of the affected side, opening the bite posteriorly on that side by interposing a layer of baseplate gutta-percha between the molar teeth before fastening the teeth in occlusion. This tends to increase the length of the jaw on the fractured side, so that when union takes place, there will be no deviation. Waldron uses a rubber biteblock of 2 or 3 mm. thickness interposed between the upper and lower molar teeth on the injured side. The use of the bite-

Fig. 7.—Fracture of body, left, reduced by open reduction. The condylar fracture in this case was merely observed, no active treatment of any type being necessary.

block, which acts as a fulcrum, tends to depress the ramus and angle, and thereby the displacement is reduced. Waldron[5] splits a short length of rubber tubing of suitable size, which tends to grasp the crown of the lower molar and prevents sideslipping.

In the edentulous jaw, displacement rather than complete dislocation of the condylar head is the rule if the injury is caused by indirect force. The bone, without the support of the teeth, absorbs the force of the blow and has more of a tendency to be markedly displaced or shattered before transmitting the force to the opposite side, where the condyle is often involved.

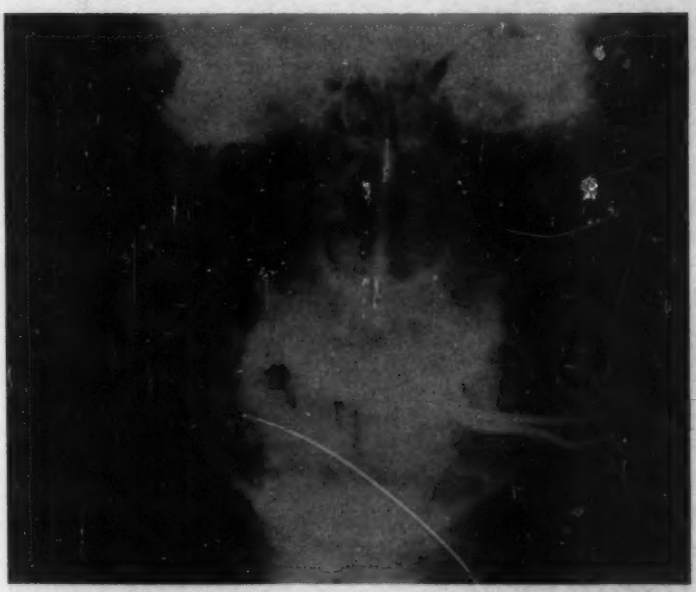

Fig. 8.—Fracture of condyle with displacement and impaction. Complete reduction could not be gained conservatively.

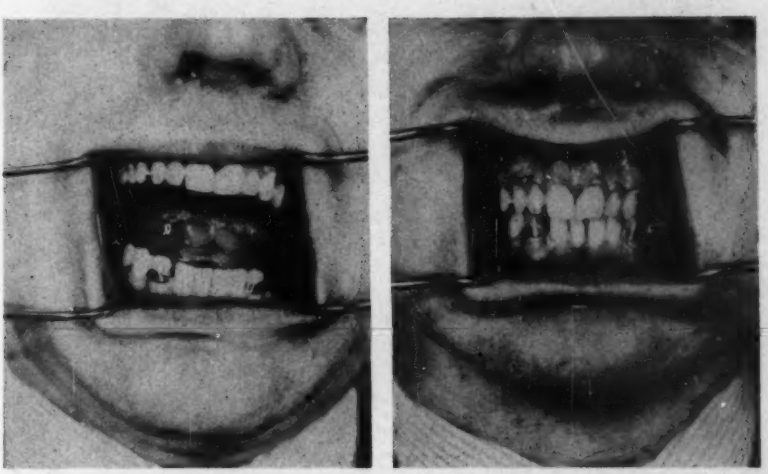

Fig. 9.—Imperfect, but certainly adequate, postoperative result. Operative interference, which might have bettered the result slightly, was decided against.

A different form of treatment must be instituted when no teeth are available for stabilization. Figure 7 shows a compound fracture of the mandible treated by open reduction and a fracture of the condylar process with displacement. In this instance, the latter fracture was merely observed. The dentures were reinserted twenty-four hours after operation, and the final occlusal deviation, which was very slight, was easily corrected by a minor change in the dentures. If considerable deformity results, a circumferential wire can be passed around the symphysis and traction to correct the jaw relationship can be established through use of a plaster headcast.[4] This offers a simple method of treatment.

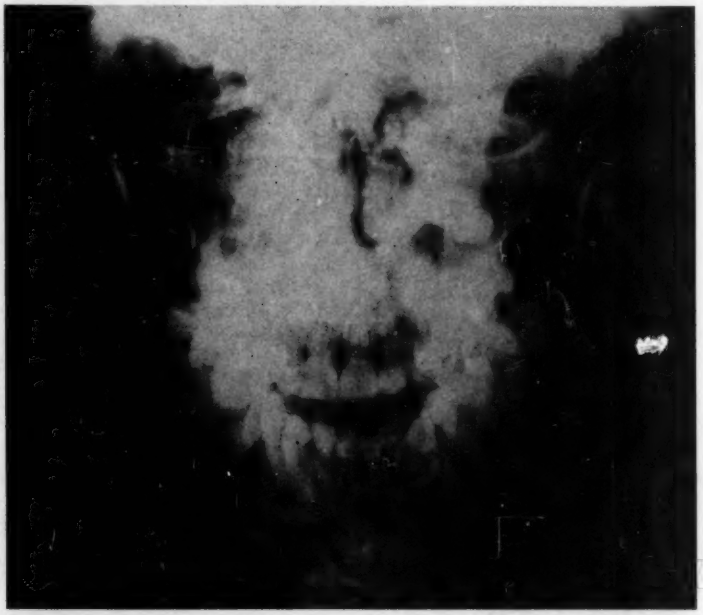

Fig. 10.—Right condyle entirely dislocated. The left was fractured with but slight displacement.

Very infrequently, an impacted type of fracture may be seen in this group. These fractures occur rather low on the condylar process and as the roentgenogram (Fig. 8) shows, there is a sharp lateral inclination of the short fragment and the ramus is pressed upward on the medial side, locking it into position. The entire mandible was displaced posteriorly at the time of the accident. Reduction using intermaxillary elastic traction was attempted, but it was impossible to overcome the impaction of the fragments or the resulting muscle spasm. Forward and lateral traction using a plaster

of Paris headcast and a labial arch bar on the lower anterior teeth was also tried, with mediocre success. Manipulation under general anesthesia was also resorted to and little accomplished. The final result, while not objectionable, could be improved upon. The patient has good functional occlusion and adequate mandibular excursion. (Fig. 9.) In such instances, open reduction can be used to advantage, but weighing the hazards of such a procedure against the possible benefit to the patient is an elementary precaution. In this case, we did not advise operation and the reduction that was accomplished conservatively was satisfactory to the patient and his family.

Class III includes twenty-five cases of this series. Again, the ideal treatment is the conservative approach. If the condyle is completely dislocated from the glenoid fossa, one can be assured that there will be no resultant interference from bony fragments once the malocclusion is corrected. Dislocation is possible because of capsular laxity, and usually the head of the condyle pierces the membrane to take a position anterior to the articular eminence. Figure 10 shows complete dislocation of the right condyle and also a fracture of the left condyle without displacement. Traction was maintained for five weeks, but it was gradually decreased until healing in the corrected position had been assured. The head of the condyle did not change its position and there was no alteration in jaw function.

In considering our fourth classification, it must be remembered that the conservative approach cannot be classified as a panacea in all condylar fractures and surgery must be recognized as an occasional necessity. Ankylosis is not a sequela of condylar fractures unless the joint surfaces are involved, and even then it is not a certainty. Ankylosis may result from traumatic injury, but it is more commonly caused by infectious arthritis, otitis media and osteomyelitis of the ramus. Bony ankylosis may result from comminution of the bony part of the joint. The immediate cause is intra-articular hemorrhage from fracture of the tympanic plate and secondary infection.

Open reduction is at best a hazardous undertaking. The distribution of the facial nerve is such that one cannot be certain that all branches will be avoided. It is very difficult to restore the condylar head to the fossa because of the attachment and spasm of the external pterygoid muscle, and although reduction may be successful, its maintenance is almost impossible. When the fracture is high on the surgical neck and surgical measures are attempted, the method of choice is complete removal of the head of the condyle and immobilization of the jaw in the corrected occlusal position. Secondary infection, a factor in ankylosis, is another possible complication of open reduction.

When there is definite involvement of the joint with comminution of bone, it is best to treat the case conservatively and remove sequestra as

UMI

they occur. The advent and increased use of the sulfonamides in chemotherapy are valuable aids in the conservative approach, especially when there are external lacerations and possible communications to the joint. A case in which such comminution occurred was handled in just this way, and although several large sequestra of tympanic plate were removed from the external auditory meatus, ankylosis did not follow and recovery was uneventful.

Another case, which has been previously reported, was seen in our clinic seven months after the original injury. No treatment for fracture of the condyle had been advised or attempted. The patient developed an abscess of the right cheek, followed by a persisting discharge and the formation of a fistulous tract. The entire sequestrated head of the condyle was removed at operation, but no other sequestra were found. A quick recovery followed the sequestrectomy, and at no time was there any deviation in occlusion. Immobilization was unnecessary.

Open reduction can be satisfactorily resorted to in fractures low on the ascending ramus when conservative methods fail to have the desired result. The many technical details of such a procedure are well discussed by various authors. It is our contention that the conservative approach is the method of choice, and surgery should only be resorted to when those efforts fail. If there is any tendency toward ankylosis, arthroplasty can be performed without much added effort.

In conclusion, we recognize that surgical interference is occasionally necessary, but it is to be condemned for routine cases. As long as results from simple immobilization are satisfactory, there can be no argument in support of needless surgical interference. To occupy its proper place, surgery should be reserved as a valuable aid in indicated cases.

BIBLIOGRAPHY

1. DINGMAN, R. O.: Use of Rubber Bands in Treatment of Fractures of Bones of Face and Jaws. *J.A.D.A.*, 26:173-183, February 1939.
2. Lectures on Military Dentistry. Chicago: American Dental Association, 1941.
3. HENSEL, GEORGE: *Internat. J. Orthodontia*, 23:814-839, August 1937.
4. IVY, R. H., and CURTIS, LAWRENCE: Fractures of Jaws. Philadelphia: Lea and Febiger, 1931, p. 78.
5. WALDRON, C. W.: Fractures of Mandible. *J. Lancet*, 62:228-240, June 1942.
6. PADGETT, E. C.: Surgical Diseases of Mouth and Jaws. Philadelphia: W. B. Saunders Co., 1938.
7. FIGI, F. G.: *Proc. Mayo Clinic*, 8:135-138, March 1933.
8. SCHAEFFER, J. E., and SKINNER, M. K.: Therapeutics of Cook County Hospital. *J.A.M.A.*, 105:21, 1679-1682, November 23, 1935.
9. BELLINGER, D. H.: Fractures and Dislocations of Jaws and Wounds of Face. *Am. J. Surg.*, 46:535-541, December 1939.
10. THOMA, K. H.: Oral Pathology. St. Louis: C. V. Mosby Co., 1941, pp. 787-792.

SKELETAL FIXATION IN THE TREATMENT OF FRACTURES OF THE MANDIBLE

A REVIEW

CARL W. WALDRON, M.D., D.D.S., Minneapolis, Minn., with the collaboration of VARAZTAD H. KAZANJIAN, D.M.D., M.D., Boston, Mass., and DOUGLAS B. PARKER, M.D., D.D.S., New York, N. Y.

THE present world conflict has produced many new problems in the treatment of fractures on account of mass bombings and consequent disorganization of the normal civilian facilities for the care of such injuries. Difficulties of transportation, the disruption of hospital routine by fire and bombs and the problem of postoperative supervision and care have made necessary the employment of procedures that make possible the removal of patients from danger without unduly jeopardizing their condition.

This is particularly true in the case of fractures of the long bones, especially of the leg, and surgeons have had an unusual opportunity to evaluate the various methods of external surgical fixation of such fractures. It was natural for the oral surgeons to try out these methods in cases of fractures of the lower jaw for, by so doing, they simplified the dietary problems of the patient with the teeth wired or splinted in occlusion. Under stress of warfare, it is obviously wise to employ the methods that are most efficient and practical under the circumstances. The experience gained has stimulated surgeons to apply these methods and devise modifications of appliances to better immobilize not only war fractures, but also many of the complicated mandibular fractures due to automobile or industrial accidents. During recent months, a number of excellent publications have appeared, presenting various appliances for skeletal fixation and the methods of their application. It is the purpose of this communication to present these articles in abstract form, to evaluate the methods as to their usefulness in and application to fractures in civilian practice, and thus encourage oral surgeons and dentists to use this method of fracture treatment when indicated and to report on their experiences and results.

Credit for the development of the treatment of fractures by external appliance and pin fixation has usually been given to Roger Anderson.[1, 2] This bone transfixion appliance is described as a new fracture unit expressly designed to meet the urgent requirements of modern and future air and sea warfare. The weight of the appliances has been reduced to a minimum. The evacuation and transportation of patients with securely immobilized fractures are greatly facilitated.

The large appliances used for the femur, etc., have been modified and

UMI

produced in miniature for use in fractures of small bones and the mandible. Figures 1 and 2 show the appliances that can be purchased. The assembly consists of two universal "Frac-sure" units, small size, each made up of two pins of medium Kirschner wire 0.060 inch (1.5 mm.), two pin clamps and a connecting unit fixation rod, weight $1\frac{2}{3}$ ounces. The pins are inserted through the skin without incisions and through the mandible about 5 mm. above the lower border. The pins are placed at an angle of approximately 70 degrees and a hand drill is recommended for their insertion. The pin clamps are then applied and connected by the rod, and thus a strong and secure fixation of the fragment is assured. A second unit is placed in the adjacent fragment. The displacement is then reduced manually and the fracture immobilized by joining the two units by means of two universal fixation rod clamps and a fixation bar. This appliance can be loosened and adjustments made in the event complete reduction and proper alinement

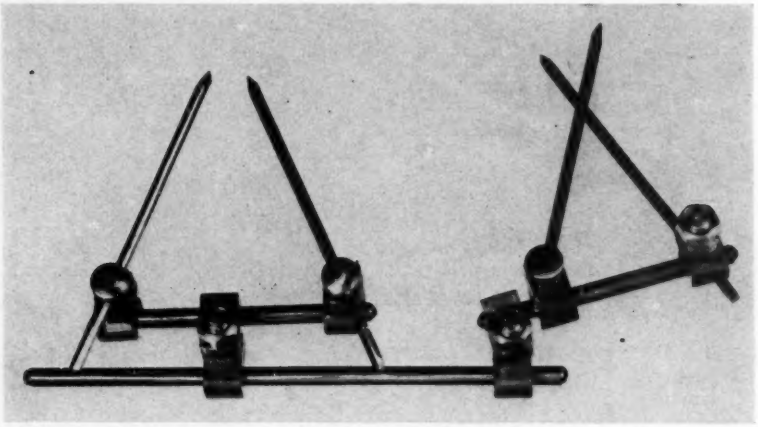

Fig. 1.—Roger Anderson fracture assembly; Converse-Waknitz technic. Each unit consists of two medium Kirschner wire pins, 1.5 mm., two pin clamps and a connecting rod. The units are joined by means of two fixation rod clamps and a fixation rod.

have not been secured at the time that it was first employed. The pin clamps and rod clamps are completely universal, permitting adjustment and fixation in any plane. This appliance is recommended for fractures of the edentulous jaw or for an edentulous mandibular fragment, but is contraindicated for fractures near the temporomandibular joint or for fractures of the lower jaw in children.

Converse and Waknitz[3] describe a small apparatus devised by Waknitz on the principle of the Roger Anderson appliances. Two converging rigid stainless steel wires similar to Kirschner wires are inserted in each fragment by means of an electric drill and must transfix both cortices of the jaw in order

to secure firm fixation. The pins are connected by an adjustable external bar by means of pin blocks to form a two-pin unit on each fragment. These units are connected by means of two adjustable universal joints and a fixation rod. The units and fragments are manipulated into alinement and the apparatus is locked. The pin units may be further strengthened by a small plaster bandage. Extra pin units can be added in cases of multiple fractures.

The method was used in a patient who entered the hospital for treatment of non-union of a fracture in the third molar region. He was injured ten

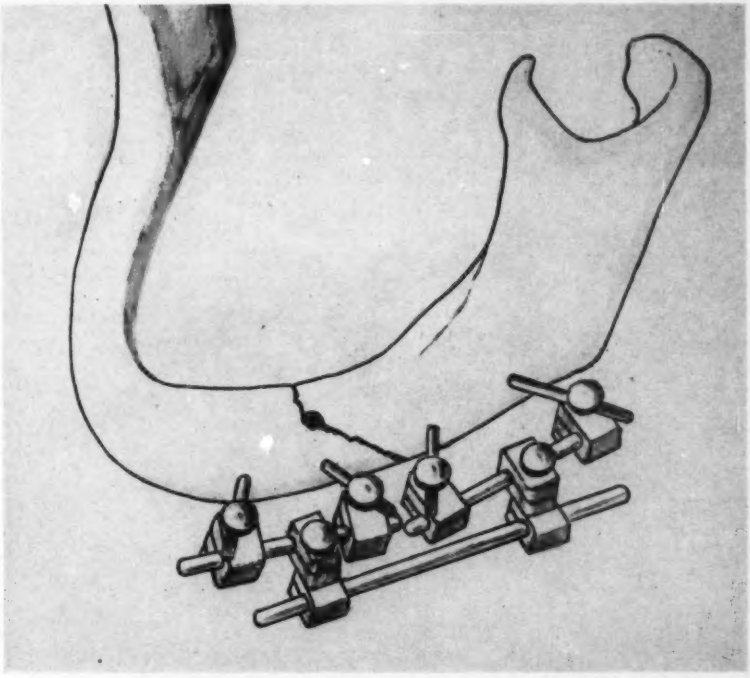

Fig. 2.—Diagram of Roger Anderson skeletal fixation splint for fracture of edentulous mandible. The pins in each fragment are inserted about 5 mm. above the lower border, converging at an angle of about 70 degrees.

weeks before the appliance was used at operation, January 8, 1941. This seems to be the first recorded use of external skeletal fixation in fractures of the mandible. A complete case report includes roentgenograms taken before and after the insertion of the appliance. The appliance and pins were removed in five weeks and bony union was complete, with satisfactory alinement of the fragments.

The authors recommend this method for displaced posterior edentulous fragments and ramus fragments that are not controlled by conventional methods. They state that in children tooth follicles in the mandible prevent its use.

One illustration in this article shows the principle rather than the mechanism of the clamp units or universal joints. A diagram of the apparatus now being used is shown in Figure 3. The fixation bar is farther away from the skin and well outside the ends of the pins. It is difficult to determine from the illustrations whether this appliance made in England is as efficient and adaptable as the Roger Anderson appliance manufactured in America that bears the name of Converse-Waknitz. (Figs. 1 and 2.)

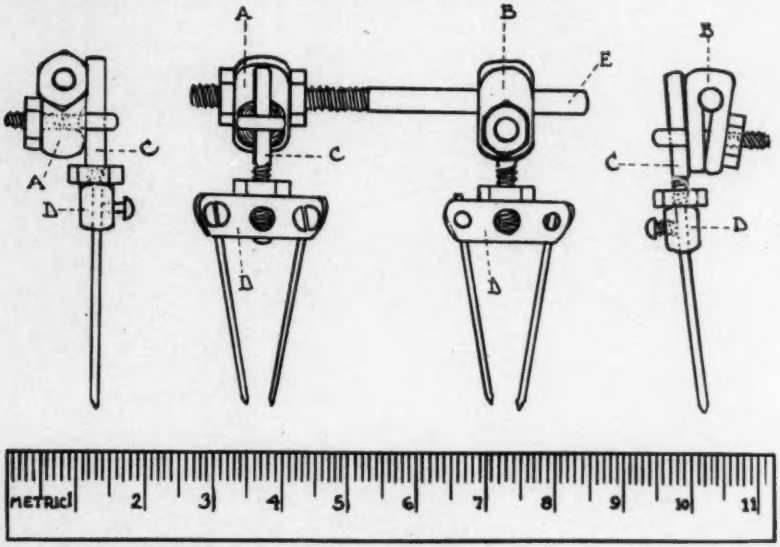

Fig. 3.—Diagram of apparatus now being used by Converse and Waknitz. The pins are inserted through the pin block D and then cut flush with the surface of the block. The pin units are joined by the attachment of universal joints A and B, which are on rod E. Great precision in reduction is obtained because small variation can be made in any one plane without loss of position in the other planes. The small size of the apparatus eliminates the inconvenience of a more cumbersome appliance. (Courtesy Converse and Waknitz, *J. Bone and Joint Surg.*)

Mowlem, Burton, Macgregor and Barron[4] have reported their experience with external pin fixation in nineteen cases of fractures of the mandible. They employ crossed Kirschner steel wires, 1.5 mm. (0.06 inch) in diameter, 2-2½ inches in length, with a sharpened short beveled pyramidal point. Two wires crossing each other at an angle of about 60 degrees before entering the bone close to its lower margin are introduced into each

fragment about one-half inch from the line of fracture. (Fig. 4.) The outstanding ends of the two wires are locked together by means of a metal plate with a slot in which are the two attachments for the fixation of the pins and a third attachment into which is locked the intervening fixation bar.

The authors describe the evolution of their apparatus. They have reduced the weight of the appliance to less than half an ounce by constructing

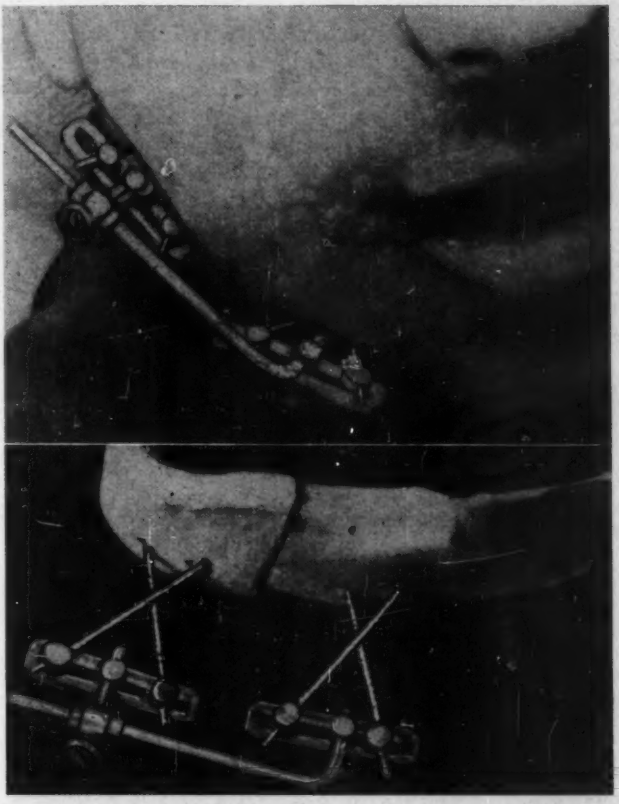

Fig. 4.—Retouched photographs of appliance on skeleton mandible and of patient showing crossed pin technic employed by Mowlem *et al.* This appliance appears to be quite adaptable and nearly if not completely universal in its adjustments. (Courtesy Mowlem *et al., Lancet.)*

it of aluminum alloy. They state that the whole apparatus is extremely simple and can be constructed by any mechanic, even without specialized tools. They believe that "the principle is worthy of further elaboration

though it is probable that it will be applicable only to chosen cases and that it should not be used to replace the simpler and more standard methods for the great majority of fractures." In their summary, the authors stress the use of the apparatus to control fractures of the mandible occurring behind the tooth-bearing area, since it affords absolute fixation, facilitates oral cleanliness, permits temporomandibular joint motion and simplifies feeding. Postoperative discomfort is negligible and external scars are so slight that excision is rarely necessary.

Gillies[6] sums up the experiences of several surgeons of a number of maxillofacial centers in the British Isles with two-pin external control of fractures of the jaw. He states that this method has been given sufficient trial for estimation of the place that it will take in the treatment of mandibular fractures. This new principle of treatment, like every other new method, will be tried out in suitable and unsuitable cases alike.

Ten cases were reported, many of which had been unsuccessfully treated by conventional methods, including one of circumferential wiring over a vulcanite gutter splint. In several, open operation of the line of fracture was necessary in order to free displaced fragments and permit reduction and immobilization by the appliances.

In one case, a bone graft previously inserted to fill a defect and stabilize a posterior fragment had become badly displaced. The graft was repositioned, and the parts were stabilized by the external pin appliances, a perfect union resulting.

X-ray diagrams and tracings of the methods are included, as well as photographs of patients.

In conclusion, his estimate of the two-pin method is as follows:

Advantages: It is available for types of fracture which cannot be treated by other methods, or which can only be treated with difficulty. It seems to be most indicated in the edentulous posterior fragment type and the displaced central fragment. Local necrosis that has occurred has involved a very small piece of bone between the two pins on a fragment that has no bearing on the treatment of the fracture.

It may be immediately applied to any fracture. There is perfect control of all fragments and anatomical reposition.

Early almost normal movement of the temporo-mandibular joint.

Cleanliness of the whole buccal cavity.

Disadvantages: The following have so far been met:

1. Local necrosis due we think to: Heat from an electric drill. A type of pin-wire which corrodes.

2. Too much confidence in the ability of the pin method to maintain a partially loosened fragment.

3. Small external scars.

The answer to the objections are as follows:

1. Local necrosis is of no importance to the fracture. Slow insertion of pins with hand drill. Use of non-corroding steel pins.

2. Thorough disimpaction of any tight fracture. N.B.—This includes removal by the surgeon of any mass of scar tissue binding the bone fragments in a false position.

3. The pin-point scars are dealt with easily if in fact they are at all offensive.

Skeletal fixation is discussed by Ferris Smith[7] in the "Manual of Standard Practice of Plastic and Maxillofacial Surgery," prepared by the National Research Council. The appliance developed by Ferris Smith in conjunction with army officers is shown in Figure 5. Two Kirschner 1.5 mm. pins, 2-2½ inches in length, are threaded and sharpened as a drill point with the external end prepared to engage a T-bar wrench. The pins are inserted

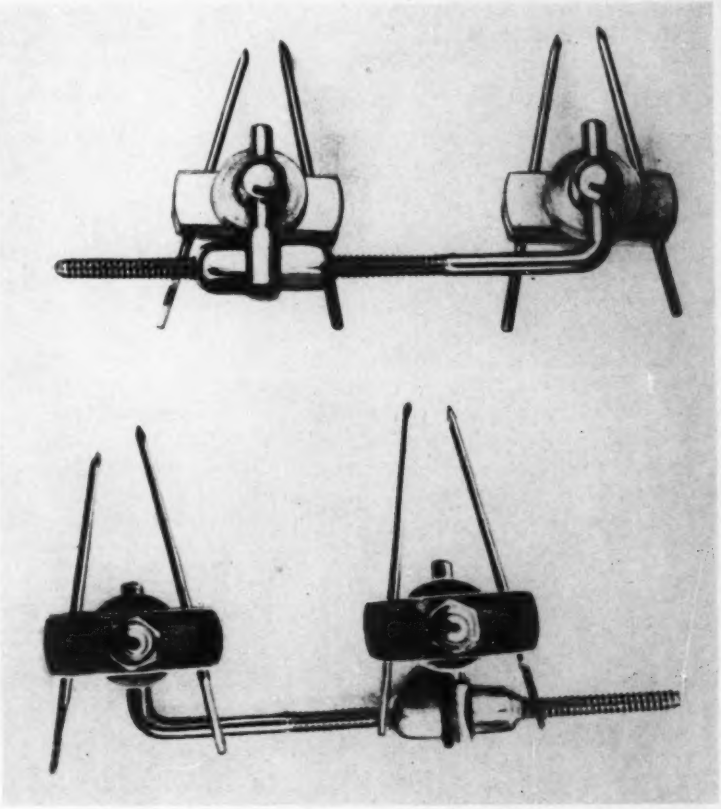

Fig. 5.—Two views of Army modification of Roger Anderson appliance for external pin fixation. (Courtesy Ferris Smith in "Manual of Standard Practice Plastic and Maxillo Facial Surgery.")

at a converging angle and the authors warn against the use of a rapidly revolving bur for the preparation of holes for the insertion of pins. Hand drilling will not burn bone and kill bone cells. A locking unit is clamped on the ends of the pins and, after reduction, the fracture is immobilized by an adjustable traction bar.

The illustrations seem to indicate that the two pins in each fragment must be inserted in the same plane, for they are held by a single locking unit of sufficient width to make fixation difficult if they were somewhat out of line. The external portion of one of the pins could no doubt be bent to overcome this difficulty. The fixation rod joining the two units appears to be efficient

Fig. 6.—Modification of Roger Anderson splint. A, hand drill. B, socket wrench. (Courtesy Roy A. Stout.)

and readily adaptable for immobilization of the fracture after it has been reduced.

The authors state:

When properly applied, the apparatus that has been described will immobilize the fragments, permit function of the mandible, and assure repair of the bone with a minimum of discomfort to the patient. The pin appliance should not be used if patients have firm and healthy teeth in each fragment, for other methods presented in this text are then superior.

Figure 6 shows the newer modification of the Roger Anderson splints

Converse-Waknitz as developed by Colonel Roy A. Stout (DC) and his associates at Walter Reed hospital.

Griffin[8] has modified a skeletal fixation splint of Haynes' for use in fractures of the mandible. Two vitallium or stainless steel screws are placed in each fragment "as far away from the line of fracture as is consistent with good fixation." The author makes a small stab incision and forces a drill through the tissue until the surface of the bone is reached. With a drill guide to protect the tissues, the cortex is drilled to produce a starting point for the screw. The author states that when deep, clean threaded screws are

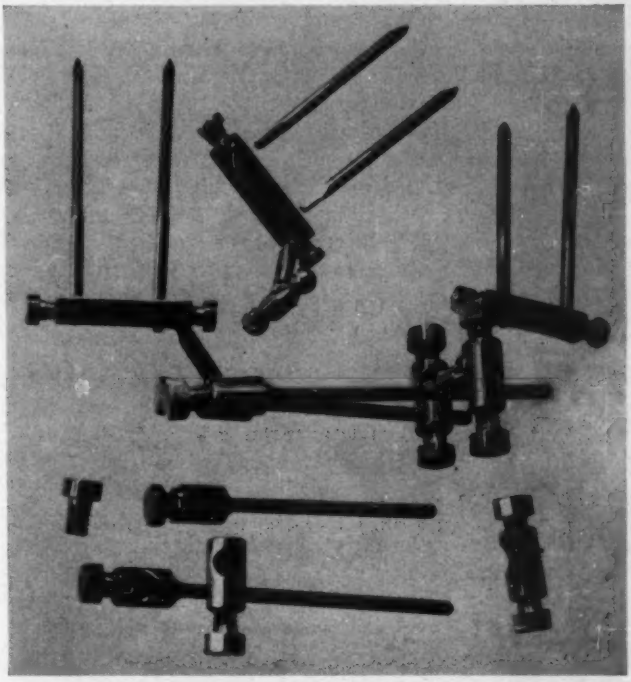

Fig. 7.—Assembly and component parts of Griffin-Haynes appliance. The fixation bar assembly permits but slight adjustment, being far from universal in three planes.

used, it is not necessary to extend the screws more than two turns through the cortical plate to secure fixation. The illustrations, including roentgenograms, however, show a shallow threaded screw rather than a deep threaded screw. The mesial screw is placed first, and a cross attachment block is placed over the screw in order to determine the position to drill and insert the second screw. The cross block is then attached to the screws. At the end of each attachment cross block is an offset T-shaped extension with

twin spheres. A similar unit is then applied to the adjacent fragment. The attachment blocks are of service in manipulating the fragments into correct alinement. They are then fixed to each other by two parallel crossbars connected by friction clamps, which grasp the twin spheres attached to each block by a short offset rod. (Fig. 7.)

The fixation parts designed to hold the units in each fragment together in one assembly are unduly complicated and the friction clamps that hold the parallel cross-bars permit but slight adjustment of the twin spheres on the T-shaped extension from each attachment block. It is obviously less adaptable than the appliances heretofore described and it requires the tightening of ten bolts to complete the assembly. This method differs from those already described in that screws are used for fixation of the fragments and they are inserted parallel to each other, not at an angle or crossed as is recommended by the orthopedic surgeons. Also, the screws do not pass through the mandible to the lingual surface as in other technics.

Four case reports are well presented. Three of these, and the appliance mounted on a skull, presented a sufficient number of teeth on both fragments to assure efficient treatment by any of the standard methods of intermaxillary wiring. Direct dental fixation of the fragments by means of an open occlusion metal or acrylic one-piece or sectional splint could have been used without closing the teeth in occlusion, or the combination of an arch bar or external arch wiring with rubber-band fixation or tie wires would have been effective.

In listing the types of cases where skeletal fixation is indicated, the author recommends its use for the majority of fractures of the mandible, in contrast to the men with considerable recent experience in England, who reserve its use for cases in which the standard methods are not usually efficient. The author stresses many advantages of the method that are largely theoretical and unduly emphasizes certain undesirable conditions occasionally associated with the conventional methods of treating fractures of the mandible.

Thoma[9] describes the Haynes-Griffin skeletal fixation appliances and technic in detail and discusses their adaptation to other situations by bending and adjustment of the crossbars; which overcomes, in a measure, the limited adaptability of the ball-and-socket joints of the friction clamps. Additional piers are added for multiple fractures. Thoma also states that the appliance can be used to effect favorable alinement of a markedly displaced condyle. A single pin is inserted through a vertical incision anterior to the tragus. He states:

It should be noted that in multiple fractures when the maxilla is involved or when condylar fractures are associated with fractures of the body of the mandible, intermaxillary ligation may be needed in addition to the Griffin appliance.

The use of the appliances in multiple fractures is extensively illustrated.

Rushton and Walker[10] report their extensive experience with skeletal fixation in twenty-one cases at Basingstoke, England. The appliance used is the Clouston-Walker evolved from the Roger Anderson Converse-Waknitz skeletal fixation splints. They have reserved this method of treatment for: (1) multiple fractures of the edentulous or nearly edentulous mandible with much displacement; (2) fractures in which there is a posterior edentulous fragment that cannot easily be controlled, and (3) cases in which it is necessary to control edentulous fragments for bone-grafting.

The main mechanical principle of this apparatus is the use of universal movement clamps. These consist of a threaded bolt with an eye at one end and a hexagonal nut at the other. Two flat rings or flanges are fitted on the bolt, one of which is countersunk so that the eye partially drops in, and

Fig. 8.—Clouston-Walker appliance used by Rushton and Walker, who state that universal movement clamps permit adjustments necessary to improve position of fragments. (Courtesy K. H. Thoma, *Am. J. Orthodontics.*)

two grooves are cut on the adjacent flat surfaces of the rings and kept in alinement. The clamps are of two sizes: one, when tightened, will hold a 2-mm. "Staybright pin" and a 3.2 mm. steel rod; the other, two 3.2 rods. The apparatus consists of T pieces upon which are fitted two pin clamps, tie bars and large clamps. (Fig. 8.) After the pins have been drilled into the bone in convergent pairs, the T pieces are firmly attached to them by the pin clamps. A suitable tie bar is then loosely threaded through large clamps placed on the long arms of the T pieces. On reduction of the fracture, the nuts of the large clamps are well tightened. The details of the parts

of this appliance are not shown in the article and it is difficult to evaluate it from a mechanical standpoint. It appears to be somewhat complicated.

Each fragment is transfixed by one pair of convergent pins. Any necessary intra-oral operations such as extraction and drainage are then performed. The clamps and pin connecting rods are applied; the fragments are brought into position by the splint connecting rod, and the clamps and rods are tightened to hold the assembly as one unit. The authors state that it is not always easy to know by feel whether a satisfactory position has been obtained. Roentgenograms sometimes show that improvement is necessary, and this is easily carried out later by releasing and retightening the clamps, without anesthesia, with local anesthesia or with intravenous anesthesia with a thiobarbiturate preparation.

Of the twenty-one cases, eleven were single fractures, eight were multiple fractures and two were old injuries requiring bone grafts. In six cases, there was acute infection at the time of operation.

In sixteen cases, satisfactory union was obtained by pin fixation. In two cases, all pins were removed early on account of inflammatory complications and union was obtained by other methods. In two others, union did not take place during the period of fixation, sequestra forming in the fracture line. One of these cases, which had previously been treated unsuccessfully with splints, was subsequently grafted. One case is still under treatment.

The authors list the following observed complications attributable to the method: (1) local sequestration due to the use of non-rustless pins or a fast-running electric drill, tiny sheath-like sequestra being subsequently removed; (2) alveolar abscess from damage to tooth roots by a pin—a technical mishap, and (3) local cellulitis of mild or severe degree, the etiology of which was apparently not determined.

The appliance was used for four weeks in most cases, and as long as seven weeks in some.

Roentgenograms of a fracture and of the appliance are shown in which a single molar with its mesial root surface in the fracture line was extracted and the posterior fragment immobilized by the appliance. Three case reports are presented to show the details of diagnosis and the operative and the postoperative course in patients with multiple fractures, edentulous fragments and extensive associated wounds of the soft parts. The pins were removed in five, five and three weeks, respectively.

Brown and McDowell,[11] in "Internal Wire Fixation for Fractures of Jaw," state that drilling of a Kirschner type wire across the fracture line may be an easy and satisfactory method of treatment in some fractures of the lower jaw in which interdental wiring cannot be applied.

Regular Kirschner or stainless steel wires 0.05 or 0.08 inch in diameter and of suitable length are sharpened at the end to a three-sided point, or

bicycle and velocipede spokes can be used. The wire is drilled longitudinally through one fragment and across the fracture line into the adjoining fragment. It is obvious that the fracture must be completely reduced to proper alinement and so held during the passage of the wire, for only "slight adjustment is possible after the wire is in." The authors recommend an electric power drill, since a "hand drill" may not give enough speed for easy penetration of the bone.

The indications for this method, according to the authors, are:

1. Cases with displacement, compound, into the mouth with infection and local sloughing in which there has been delay in treatment and the opportune time for interdental fixation has passed.

2. Extensive comminution, as in gun-shot and war wounds, with many teeth loosened or broken.

3. Displaced fractures of the symphysis.

4. Fractures at the angle with outward and upward displacement of the posterior fragment.

They add: "It may also be considered in edentulous jaws . . . it may also prove to be of value in certain separations of the upper jaw."

The internal wires insure fixation in one plane, the vertical, but they may rotate on the axis of the wire or may pull apart. Internal dental arch wiring will prevent rotation and join the fragments to prevent separation. The "further addition of interdental fixation to the upper jaw" may be necessary to secure normal occlusion. To maintain the fragments in apposition, the authors have cut threads with a 2-56 die on an 0.08 wire (bicycle spoke threader), which permits screwing down bicycle spoke nipples or small nuts over each end of the wire against the bone. The threaded wire may engage and prevent separation and "is applicable to edentulous cases." Avoidance of the nerve is advisable.

Photographs and roentgenograms of four patients are shown. In three, direct dental arch wiring was used to supplement the internal wiring. Two wires, one above the other, were used in one case. In one case, the internal wire was placed to immobilize an overriding fracture of the angle, and direct dental wiring was used to secure a fracture in the bicuspid region.

The authors give credit to Ipsen and Sobye, Denmark, and Meade, Ireland, for previously reporting this method.

Comment.—This method deserves further study and determination of the indications for its use. The technical difficulties of correcting displacement and holding the fragments in perfect alinement during the process of inserting the wire are considerable. Many mandibles are so thin and curved in the region of the angle and lower portion of the ramus that the insertion of a wire in a straight line forward into the body is impossible. Furthermore, examination of a number of mandibles in cross-section reveals that, in this region, there is practically no cancellous bone between the cortical

UMI

plates. In the molar region, the inferior dental canal may be located within 2 mm. of the cortical bone of the lower border and injury to the nerve could hardly be avoided in many cases. Drilling across an exposed fracture line is surely subject to criticism from a surgical standpoint in view of the fact that other efficient methods of securing and immobilizing displaced fragments by various methods of skeletal fixation at a distance from the fracture line are available.

Pohl[12] reviews most of the surgical methods that have been recommended for the treatment of displaced fractures of the edentulous mandible and for edentulous posterior fragments and ramus fractures. He discusses the technic and the problems and complications incident to the application of nails, screws, wires and plates to the mandible, and has concluded that the

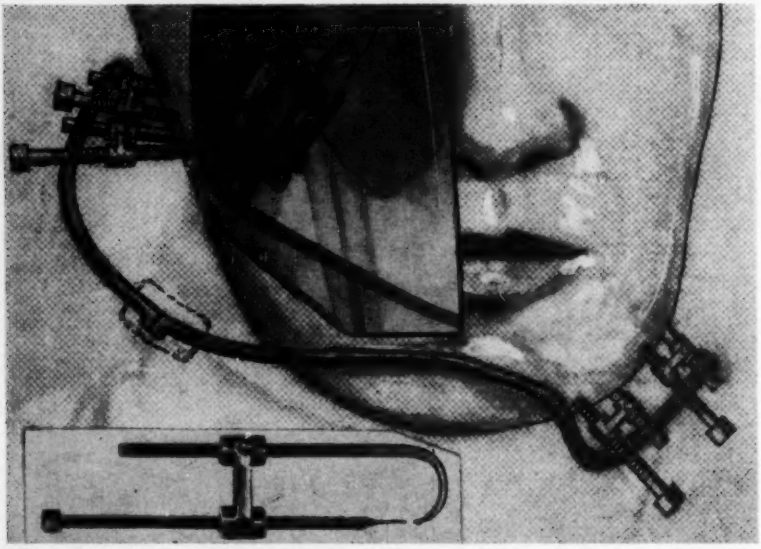

Fig. 9.—Pohl hook screw appliance (composite, retouched photographs from author's article). Inserts: Hookscrew and roentgenogram. (Courtesy Pohl, *Lancet.*)

results of the various methods are not invariably satisfactory. To overcome these disadvantages, the author had modified Bruhn's hook extension used for the elevation and retention of a depressed fracture of the malar bone. He describes a hook-screw appliance, the insertion of which only superficially into the bone results in fewer cases of necrosis. Its principle is the extra-oral application of hook-screws into each fragment of the fractured-mandible, and connecting them with a bar welded to them *in situ*.

Details of Method.—The hook-screw (Fig. 9) is made of stainless steel in three sizes. It consists of three main parts: (1) a hook ending in a sharp

point, the shaft of which is square in cross-section; (2) a simple screw tapered at one end with a square head at the other, and (3) a rod connecting the two. The connecting rod is threaded at one end for the screw, and has a square hole at the other for the hook, as well as a locking screw.

The site of insertion of the hook-screws depends on the type of fracture, the extent of external injury present, etc. It is applied best at the thickest part of the bone and as far from the line of fracture as is considered necessary. Before application, the hook-screw is taken to pieces, and after the skin is surgically cleansed, the hook is inserted so that injuries to vulnerable organs are avoided as nearly as possible. As soon as one can feel bone, either slight pressure or traction is exerted. While the fragment is thus held in position with one hand by means of the hook, the connecting rod, together with the screw, is slipped over the hook and then screwed tight. The screw is screwed down and advanced into the compact bone only, in order to avoid any injury to the bone marrow. Two or more hook-screws may be applied to the body of the mandible and one or two to the ramus to obtain sufficient stability.

The author connects the hook-screws of one fragment to those in the other fragment by means of a stainless steel bar, which is bent to shape and kept at least 1 inch away from the surface of the skin. The fragments are then properly alined and the apparatus joined by welding. The skin is protected by wet gauze and a cold water spray is used to cool the metal. The appliance can be severed and further adjustments made, and rewelded or additional appliances may be welded to the bar without removal of or interference with the splint.

It is obvious that the hook-screw units in one fragment could be joined together by various attachments and those from one fragment held to those in the other by a connecting rod and universal joints.

This method may well be of service in combination with other methods, particularly for the control of weak and friable posterior fragments that tend to split on drilling. It might also be of value in certain displacements in children when screws or pins might injure the developing permanent teeth.

Berry[13, 14] describes a screw implantation method for the immobilization of fractures of the edentulous mandible and for the control of an edentulous posterior fragment. The assembly consists of specially designed vitallium screws with a slotted end to facilitate insertion in the bone, tubelike sleeves that fit over the screws and an alinement rod of 14-gage chrome wire. The screws are drilled through at the junction of the threads and the shank and the upper end of the sleeves are drilled through to permit insertion of the alinement rod. The screws are inserted in the fragments in a vertical direction after a hole of slightly smaller diameter is drilled to facilitate penetration of the bone. The author recommends that the screws be placed from

the alveolar process ridge down to or just through the cortex of the lower border, and two screws are inserted in the anterior fragment of the mandible and one screw in the posterior fragment. In one diagram showing a dropped intermediate fragment, one screw is shown in each fragment. The alinement rod is bent and adjusted to secure the sleeves, screws and fragments in alinement, where they are held by tie wires passed through the holes in the heads of the screws and twisted over the alinement rod. The author believes that he can avoid nerves and blood vessels in inserting the screws distally from the mental foramen, but believes that injury to the nerve and artery is not a serious accident and, should it occur, nature will rebuild them. When teeth are present, a fractured segment distally from the teeth is secured with one screw-sleeve and an alinement rod wired to the teeth in the anterior fragment.

The technic for external application of the appliances is presented. The bone is exposed through an external incision and the screws are inserted

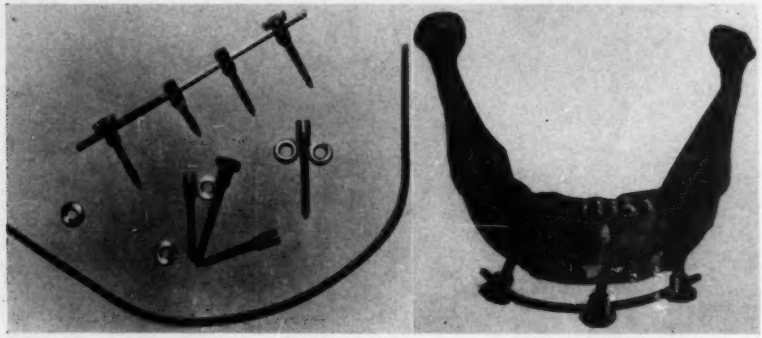

Fig. 10.—Bigelow appliance, vitallium screws with slotted heads, thumb nuts and alinement bar; assembly on mandible; screws inserted vertically into lower border. The usual technic is horizontal insertion into the buccal surface.

from the side in the same manner as in the intra-oral method. An external alinement rod is adjusted and the incisions are sealed with cotton and collodion.

Four cases of the intra-oral application of the implantation method for fractures of the edentulous mandible are reported. The appliances were removed in seventeen, nineteen, twenty and twenty-one days, respectively.

The author reports one case of multiple fracture with subsequent osteitis and necrosis in which the external appliance was used. The teeth were first wired in occlusion in order to steady the fractured segments during insertion of the screws through skin incisions and adjustment of the alinement rod. Infected teeth, sequestra and necrotic bone were removed. The intermaxillary wires were then removed, but were later reapplied to improve the

alinement of the teeth and fractures. Complete regeneration resulted.

Thoma[9] discusses the Berry method of implantation and presents illustrations showing additional stabilization of the appliances by wiring and the use of a split rubber tubing over the entire appliance to protect the tongue and cheeks from irritation. He also discusses and illustrates the extra-oral screw implantation method and presents illustrations of its application. This appliance obviously is not so strong as most others and requires the bending and adjustments of the alinement rod to secure fixation in proper position.

Bigelow[15] reported the insertion of screws through the skin and subcutaneous tissues into the mandible. After reduction of the fracture, the ends of the screws are joined by a splint or incorporated in plaster. He has since developed another appliance which consists of an alinement bar which is one-tenth of an inch square on cross-section. The vitallium screws have slotted heads that just accommodate the bar. These heads are threaded to permit the use of a nut, which fastens the bar firmly in the slot after the

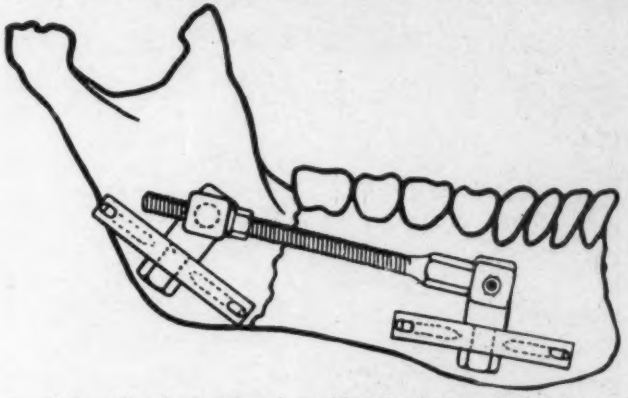

Fig. 11.—Stader splint for fracture of mandible distally from third molar tooth. This splint appears to be adjustable in two planes, the anterior-posterior and the vertical. (Courtesy Shaar and Kreuz, *S. Clin. N. America.*)

screws have been inserted in the fragments. This assembly prevents movements on rotation in any direction. This rigid appliance (Fig. 10) is very simple, inexpensive and light in weight and can be secured from the manufacturers of vitallium. It is obviously necessary to bend the alinement rod in order to adapt it to the position of the slotted screws.

Gross[16] describes the fixation of a posterior fragment by means of an external screw into the bone, which, in turn, is held by an extra-oral arm that passes through the lips to a vitallium open occlusion splint attached to the lower teeth. The arm is attached to the screw by means of a plate.

Strock[17] presents an interesting intra-oral application of three-quarters inch vitallium screws and 1½ inch vitallium plate in a fracture of the

edentulous mandible. A narrow plate was placed in tight contact with the mucous membrane of the external surface by the alveolar process deep in the buccal fold at a lower level than the denture, which he was able to wear with the plate in position. The mucous membrane around the plate proliferated to almost cover it, but there were no signs of irritation or inflammation. To determine the toleration of the tissues, the plate was left for three months and, a month after its removal, there was no trace of the tissue that had covered the plate.

Parker[18] discusses external fixation by pin and screw fixation by the Roger Anderson technics, Army modification and Haynes-Griffin and appliances using the upper unit of Starrett surface gage as a universal joint. He modi-

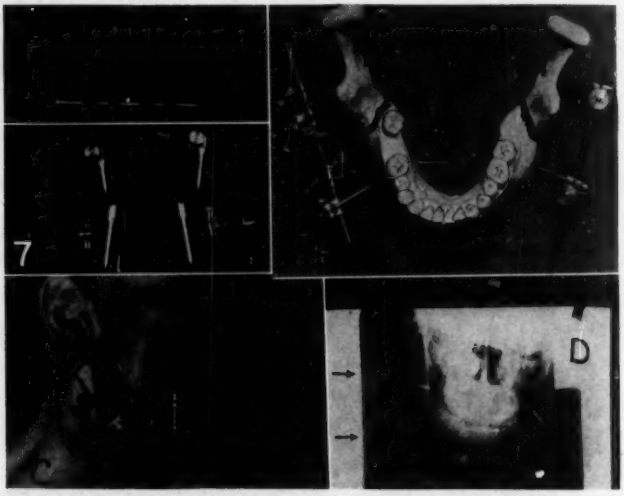

Fig. 12.—A and B, assembly for skeletal utilizing universal joints with twin pins or single vitallium screw in each fragment. C, patient with vitallium screw appliance. D, postero-anterior roentgenogram showing appliance in same case. It must be noted that if twin pins are used in each fragment, one pin may be inserted in each fragment before reduction, preferably the one nearest the line of fracture. The fixation rod is then applied to the two pins by means of two Starrett joints. The fracture is then reduced and the joints tightened to immobilize it. One additional Starrett joint is then slipped on each end of the fixation bar. The second pin for each fragment is inserted through the Starrett joint and drilled through the mandible at a converging angle with the pin originally inserted in the respective fragment. It is virtually impossible to insert four pins in straight alinement on a fixation rod. Furthermore, this assembly does not permit subsequent improvement of the position of the fragments without removal of one pin from each fragment.

fied the latter by adding a rigid clamp to hold two vitallium screws in one fragment, which, in turn, were secured by a modification of the Starrett joints. He says, "It is not advisable to use appliances for external fixation

if there is sufficient anchorage within the mouth to secure adequate fixation in proper alignment."

This principle of fracture treatment has been employed in veterinary surgery by Otto Stader since 1931, and the Stader splint has been modified and used in fractures of long bones in human beings. This has been recently reported by Lewis, Breidenbach and Stader.[20]

C. M. Shaar and F. P. Kreuz, Jr.,[21] report six fractures of the mandible treated with the Stader reduction splint. Three were fractures of the angle with edentulous proximal fragments, in one of which osteomyelitis was a complication. There were two cases of multiple fracture of the mandible

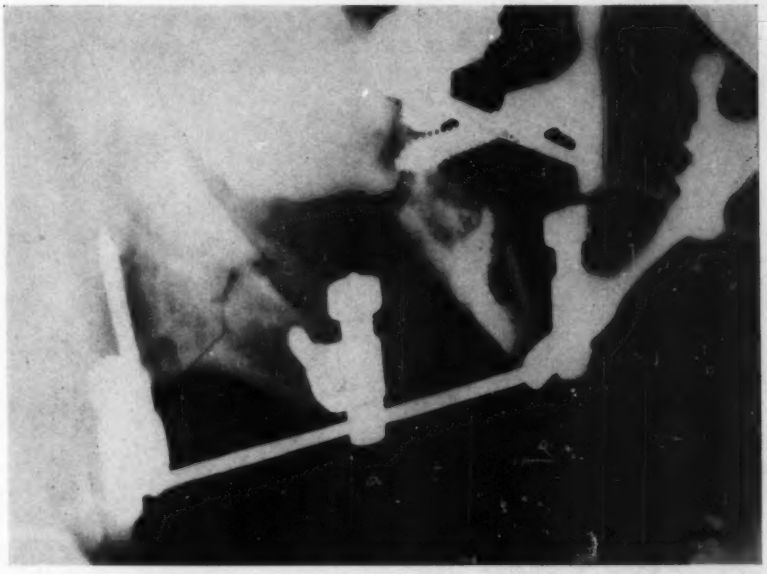

Fig. 13.—Lateral roentgenogram showing use of vitallium screws in bilateral fractures of edentulous mandible, with the Starrett universal joints and fixation rod.

requiring multiple units, and one instance of a fracture of the symphysis mentis. The authors give two case reports with illustrations. In one, there was a fracture with an edentulous posterior fragment and osteomyelitis. The splint was left on for seventy days. The second case presented a fracture at the symphysis and angle and required the application of a multiple unit splint. The splint was left on for forty-four days, after which a residual malocclusion was corrected by rubber bands.

One diagram of the splint shows its application in a symphysis fracture with all teeth present, where it would not be indicated in civilian practice.

It might be of valuable service for the treatment of fractures in the tooth-bearing areas under conditions of combat upon ships at sea.

The second diagram (Fig. 11) shows its application in a fracture distally from the third molar tooth. This splint does not appear to be universal in all three planes.

It is of interest to note that the authors add as a footnote the following: "We wish to point out that in the treatment of fractures of the mandible by means of external fixation, it is essential to have the cooperation of a qualified orthodontist, because the ultimate aim of treating fractures of the mandible should be perfect occlusion."

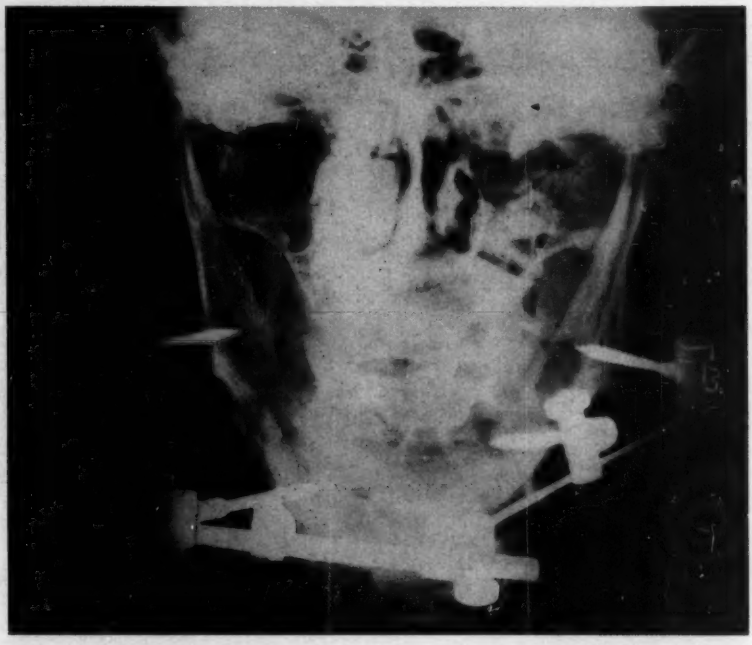

Fig. 14.—Postero-anterior roentgenogram of case in Figure 13, showing simple vitallium screw on each side of lines of fracture.

My personal experience with skeletal fixation and fractures of the mandible is limited to three patients (seven fractures). The first[19] was one of bilateral fractures at the angle and a symphysis fracture in a man who had suffered from severe bronchiectasis for several years. Two attempts to reduce the fractures and wire the teeth in occlusion under ether anesthesia resulted in aggravation of the pulmonary infection necessitating cutting the tie wires on account of cough and profuse expectoration. The displacements

recurred and the patient was sent to Minneapolis after five weeks. The internist and the thoracic surgeon called in consultation stated that the condition of the lung and expectoration made it impossible to wire the teeth in occlusion. The symphysis fracture was reduced and held by fulcrum Risdon external arch wiring. Wires were placed on the upper teeth to permit the use of rubber bands at intervals for short periods of time to correct the open bite displacement. Six weeks after the injury, under procaine anesthesia, the markedly displaced posterior fragment on the right side was freed and transfixed by a vitallium screw with a special elongated head made to fit a Starrett universal joint. (Fig. 12.) A second screw was placed in the anterior fragment and, after reduction of the displacement, the two

Fig. 15.—Second patient with bilateral fractures of edentulous mandible showing assembly used in Figures 13 and 14. Two Starrett joints with a brass rod in front of the chin were used to provide additional stabilization.

screws were held firmly by tightening the two Starrett joints on the screws and fixation bars. (Fig. 12.)

The condition went from bad to worse, with extensive lung involvement, with necrosis and suppuration, in spite of medical care and rib resection and drainage. The skeletal fixation appliance was removed in twenty-six days. The posterior screw had become loosened, probably because the patient had been toxic and somewhat delirious at times and had rolled over on the appliance. Clinical examination showed the union of the fracture

UMI

to be progressing with but slight spring on strong manipulation. The patient died forty days after removal of the appliance, at which time bony union was nearly complete.

Similar appliances were used for the treatment of two edentulous patients with bilateral, displaced overriding fractures of the body of the mandible. Two vitallium screws were inserted in the fragments on both sides. The appliances were then united anteriorly by two additional Starrett universal joints and a brass rod that afforded additional stabilization for the screws, particularly those in the central fragment. (Figs. 13 and 14.) This anterior rod might also be used in conjunction with a head appliance to overcome the tendency toward depression of the symphysis and open-bite

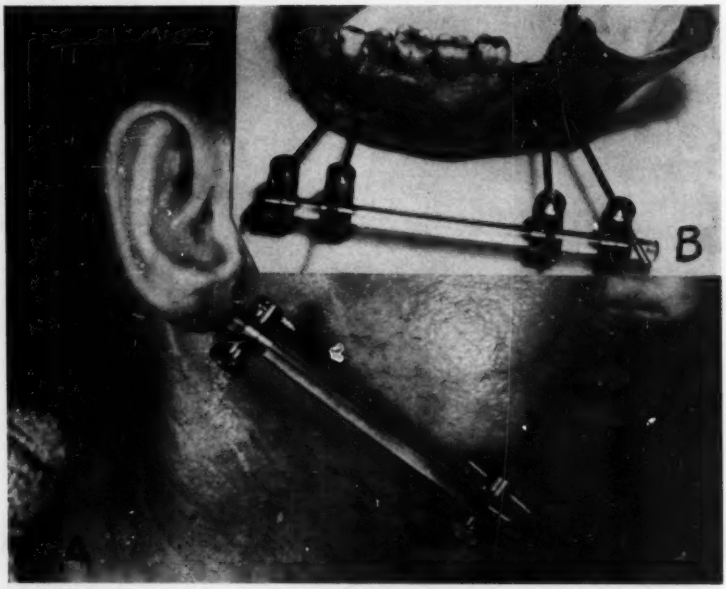

Fig. 16.—Ivy's modification of skeletal fixation appliance using lucite rod, Starrett joints and single and twin pin fixation of fragments. The lucite rod can be heated and bent. A, patient with single pin in each fragment. B, twin pin assembly on each fragment of mandible. The difficulties noted for four pin appliances connected by one fixation rod (Fig. 12) hold true for this splint. These are considerably lessened by the fact that the lucite rod may be heated and bent. (Courtesy R. H. Ivy.)

deformity. This difficulty was noted in the first case, which presented a very much resorbed mandible and relatively slow processes of union. The screws were inserted on the left side on the sixth day after injury. It was hoped that a denture splint and bandage would be sufficient for the fracture on the right. Displacement recurred and the right side was reduced and

fixed with screws and rod four days later. On removal, after forty-nine days, three screws were found loosened, but the screw in the right anterior fragment was so firmly embedded that considerable force was necessary to loosen and remove it.

The second patient was treated in a similar manner on the tenth day after injury. (Fig. 15.) There was much more bone in the body of the mandible in this case, and the appliance was quite secure. The screws were removed forty days later. Those on the right side were found loosened; those on the left were quite tight, especially the one in the posterior fragment. Union of the fractures was complete.

These three cases may be considered as reasonably successful, but not altogether so, and I believe that the use of the twin pin unit Converse-Waknitz-Roger Anderson appliance will prove of much greater value in future patients we may be called upon to treat by skeletal fixation. I believe that some modification and lengthening of the fixation clamps uniting the

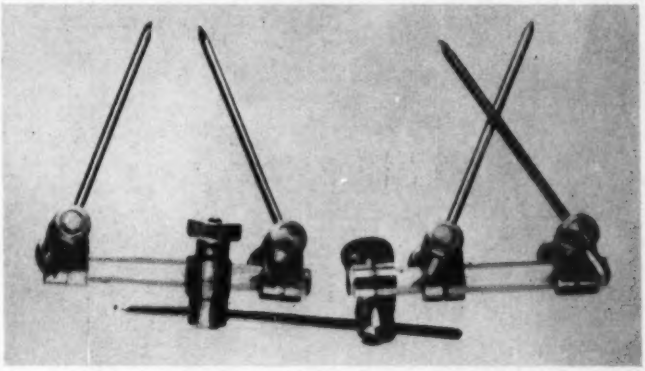

Fig. 17.—Author's modification employing short lucite connecting rod between two pins in each fragment to produce unit similar to Roger Anderson splint. (Fig. 1). The units in each fragment are united by placing two Starrett joints over the projecting ends of the unit lucite rods and uniting them with a steel fixation rod. This provides universal movement and adaptation. The rod can be manipulated readily. This appliance is not so light as the Roger Anderson splint, but it is effective and can be readily assembled by surgeons who already have the Starrett joints.

fixation bar of this appliance will make it more adaptable and effective in every particular.

At the time that these patients were treated, I was unaware of any available splints for this purpose, and so the Starrett universal joints, which had been used so effectively for many years in our head cap assembly for certain fractures of the maxilla, were used. Many surgeons and military officers have secured from six to ten of these Starrett joints for the construction of head caps, and these joints can be used effectively for skeletal fixation of

fractures of the mandible by securing two $\frac{7}{32}$ lucite rods, 2 inches long. These, with four Starrett joints and four pins, will make two converging pin units. These are joined by means of two additional Starrett joints and a fixation rod. (Fig. 17.)

The use of a lucite rod was suggested to me by Dr. Ivy. (Fig. 16, A and B.) The difficulties of alining four pins on one rod has been discussed. These difficulties can be somewhat reduced because of the fact that lucite can be heated and bent.

In this review of the published methods of skeletal fixation in fractures of the mandible, I have tried to be fair in the appraisal of the methods and the appliances.

Varaztad H. Kazanjian, of Boston, and Douglas B. Parker, of New York, have checked the subject matter of this contribution and we join in the following summary and conclusions.

SUMMARY AND CONCLUSIONS

The present methods of skeletal fixation as used by a number of men are the logical refinements of what preceded, and they will undoubtedly go through a further developmental stage until they assume a definite and permanent place in the treatment of fractures of the mandible. There are many possibilities for its employment when used intelligently, but we also fear its misuse in the hands of the overenthusiastic. The illustrations and roentgenograms of many published reports show its use in cases wherein the standard and simpler procedures could have been employed with a greater assurance of a more nearly perfect restoration of the occlusion of the teeth.

We believe that this will prove useful:

1. In badly displaced fractures of the edentulous mandible, particularly when comminuted.

2. In fractures behind the angle of the mandible when the posterior fragment becomes difficult to retain with the ordinary accepted methods.

In many of these cases, it will be wise to wire the remaining teeth in occlusion to further assure the stabilization of the fracture and the appliance. Occasionally, it may be impossible to close the teeth in occlusion on account of bronchiectasis or other systemic conditions.

3. In certain types of multiple fractures involving both upper and lower jaws wherein dental splints, on account of the loss of many teeth, are not altogether satisfactory.

4. When no facilities are available for construction of dental splints.

5. To the surgeon who does not have the services of dental surgeons. He will naturally find skeletal fixation more consonant with his training, and will feel justified in its use.

6. In comminuted fractures of the mandible with destruction of a sec-

tion wherein the isolated parts cannot be held adequately with dental splints because of the loss of teeth for use as anchorage. (The same appliance could be used in case bone grafting should become necessary.)

In conclusion, let us welcome any new method of fixation offered for the treatment of fractures, but we should be discriminating and critical at first, and use it intelligently. Otherwise, failures may not only do harm to the patient, but may also bring disrepute to the method which it does not deserve.

BIBLIOGRAPHY

1. ANDERSON, ROGER: *Surg., Gynec. & Obst.*, 62:865-873, May 1936.
2. ANDERSON, ROGER, and FINLAYSON, B. L.: Sequelae of Transfixation of Bone. *Surgery*, 13:46-54, January 1943.
3. CONVERSE, J. M., and WAKNITZ, F. W.: External Skeletal Fixation in Fractures of Mandibular Angle. *J. Bone & Joint Surg.*, 24:154-160, January 1942.
4. MOWLEM, R., *et al.*: External Pin Fixation for Fractures of Mandible. *Lancet*, 2: 391-393, October 1941.
5. MOWLEM, R.: Review of Fixation Methods from Standpoint of Plastic Surgeons. *Brit. D. J.*, 71:323-327, November 1941.
6. GILLIES, H. D.: Replacement and Control of Maxillo-Facial Fractures. *Brit. D. J.*, 71:351-358, December 1941.
7. Manual of Standard Practice. Plastic and Maxillo Facial Surgery. Philadelphia: W. B. Saunders Co., 1942.
8. GRIFFIN, J. R.: Treating Fractures of Mandible by Skeletal Fixation. *Am. J. Orthodontics*, 27:364-376, July 1941.
9. THOMA, K. H.: Traumatic Surgery of Jaws. St. Louis: C. V. Mosby Co., 1942.
10. RUSHTON, M. B., and WALKER, F. A.: Mandibular Fractures Treated by Pin Fixation. Twenty-One Cases. *Am. J. Orthodontics*, 28:135-143, May 1942.
11. BROWN, J. B., and MCDOWELL, FRANK: *Surg., Gynec. & Obst.*, 74:227-230, February 1942.
12. POHL, LEANDER: Extra-Oral Splinting of Edentulous Mandible. *Lancet*, 2:389-391, October 1941.
13. BERRY, H. C.: New Departure from Orthodox Methods of Setting Fractured Edentulous Mandibles. *J.A.D.A.*, 28:388, March 1941.
14. BERRY, H. C.: Implantation Method for Setting Fractured Mandible. *Am. J. Orthodontics*, 28:292, May 1942.
15. BIGELOW, H. H.: *M. Bull. Veterans Adm.*, 17:54-56, July 1940.
16. GROSS, P. P.: Treatment of Posterior Fragments in Edentulous Fractured Mandibles. *D. Digest*, 46:384, November 1940.
17. STROCK, A. E.: Method for Treating Edentulous Mandibular Fractures. *Bull. Connecticut D. A.*, 17:17, November 1940.
18. PARKER, D. B.: Synopsis of Traumatic Injuries of Jaws. St. Louis: C. V. Mosby Co., 1942.
19. WALDRON, C. W.: Fractures of Mandible. *J. Lancet*, 62:228-240, June 1942.
20. LEWIS, K. M.; BREIDEN, B. L., and STADER, OTTO: Stader Reduction Splint. *Ann. Surg.*, 116:623-636, October 1942.
21. SHAAR, C. M., and KREUZ, F. P., JR.: Treatment of Fractures and Bone and Joint Surgery with Stader Reduction and Fixation Splint. *Surg. Clin. N. America*, 22:1537-1583, December 1942.
22. IVY, R. H.: Personal communication to author.
23. WALDRON, C. W., and BALKIN, S. G.: Fractures of Maxilla. *Surgery*, 11:183-194, February 1942.

UMI

Case Reports

PRIMARY LYMPHOSARCOMA OF THE MANDIBLE

KENNETH W. PENHALE, D.D.S., M.D., F.A.C.S., Chicago, Ill.

THE rarity of lymphosarcoma beginning in a bone warrants the report of this case.[1] By far the overwhelming majority of cases of this malignant tumor begin in a group of lymph nodes. Much less frequently, such lymphoid masses may secondarily invade bony structures adjacent to them. Extremely infrequent are those cases beginning in the bone itself.

HISTOGENESIS

Lymphosarcoma is a malignant blastoma originating from the reticulum or reticulo-endothelial cells.[2] These cells occur predominantly in the lymph nodes, bone marrow, liver and spleen, athough, as previously mentioned, this tumor is rare outside the lymph nodes or lymphoid structures. Even in classic advanced cases, the bone marrow, liver or spleen is involved with extreme rarity,[3] despite the fact that these organs contain the identical cell type of the lymph nodes.

Once begun, lymphosarcoma may manifest itself as the reticulum-cell type or the more mature lymphocytic type.[4] The case here reported is of the more primitive reticulum-cell type.

The course of lymphosarcoma is uniformly fatal.

History.—A white man, aged 28, seen in January 1940, gave a history of pain in a lower right molar, which had been removed on his demand three months previously. After the extraction, he had no pain, but a swelling developed in the region of the extracted tooth that had never completely subsided. At times, the swelling would increase as is shown in Figure 1.

The patient continued working as a special mechanic in a shoe manufacturing firm. Several weeks passed with no apparent discomfort except for the hard swelling and occasional sensation of pain in the region of the extracted tooth. The patient later noted a numbness of the lower lip (right side), which was attributed to the nerve block given at the time of the extraction.

Examination.—There was a noticeable swelling of the body of the right mandible, especially in the region of the lower extracted tooth. There was some tenderness about the molar socket, which was filled with hypertrophied tissue. (Fig. 2, left.) The temperature was 99.4.

There was nothing unusual about the clinical picture except for one outstanding subjective symptom, numbness of the lower lip (right side) and a beginning numbness of the lip on the left side. (Fig. 2, right.)

A report of the x-ray examination of the right and left lateral jaw was as follows: "There is an area of decreased density in the lower right second molar area. The shadows have more the appearance of an incomplete calcified bone where there is an extraction of the tooth than of an inflammatory reaction.

The area of the posterior root shows a little greater transparency than the anterior root. This could be on the basis of a beginning or low grade inflammatory change. The opposite jaw, taken for direct comparison, is normal." (Figs. 3 and 4.)

On the basis of the subjective symptoms (numbness of the lower lip), surgical interference was advised, primarily for investigation, with a tentative diagnosis of low-grade infection.

Operation.—Three days later, under general anesthesia, the lower right (firm)

Fig. 1.—Swelling of right jaw with no apparent swelling of left jaw or cheek.

second bicuspid tooth was removed and the two cavities, bicuspid and molar, were connected and enlarged. It was immediately detected that the cancellous bone was soft and spongy. A blunt probe could be inserted easily, as if in a partially filled cavity. In the belief that the same phenomenon had extended to the left side, the lower left first molar was extracted. A probe was not so easily inserted on the left side, but it was evident that the destructive process was present on that side as well, although not in so great a degree.

UMI

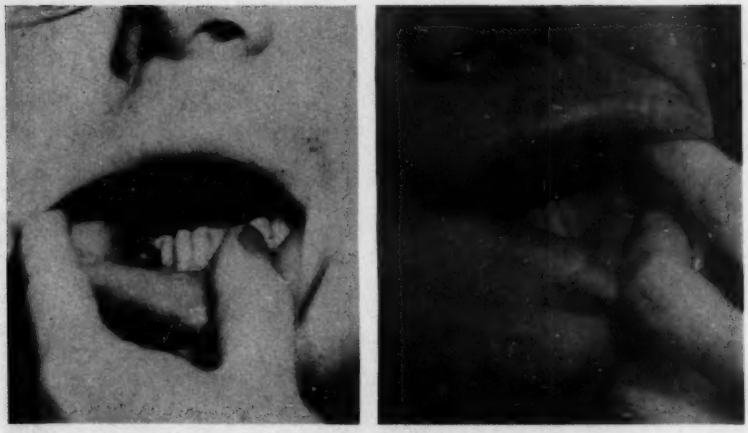

Fig. 2.—Left: Region of extracted molar filled with unhealthy granulation tissue. Right: Lack of clinical evidence of pathologic process.

Fig. 3.—Right lateral jaw (bone pattern difficult to interpret).

Sufficient cancellous and cortical bone was removed for gross and microscopic examination. Both cavities were packed with iodoform gauze to prevent bleeding. The patient remained in the hospital awaiting the microscopic report and further checkup.

UMI

Microscopic Report.—Microscopically, the subepithelial tissues of the mucous membrane were infiltrated by closely packed single cells without definite stroma. The cells were round to oval, with a scant pale cytoplasm, and round to oval pale nuclei with occasional nucleoli. Some nuclei were indented or lobulated, and there were many mitotic figures.

Histologic Diagnosis.—The diagnosis was lymphosarcoma of the reticulum-cell type.

Course.—The iodoform gauze drains were removed from the biopsy wounds with no subsequent bleeding. On admission, the red blood count was 4,810,000; the white count, 9,350, with 70 per cent polymorphonuclear leukocytes, 20 per cent lymphocytes and 10 per cent monocytes, and hemoglobin, 90 per cent. The urinalysis was negative, as were the Wassermann and Kahn reactions.

Fig. 4.—Left lateral jaw with no evidence of bone change.

X-ray therapy under the direction of P. A. Nelson, Mercy Hospital, was immediately initiated as a palliative measure, in recognition of the rapid symptomatic response of these cellular neoplasms to x-ray irradiation. The swelling of the right jaw responded very favorably.

Within two weeks, the patient began complaining of abdominal cramps and slight nausea. These symptoms abated in a few days, but recurred with progressing severity and with loss of appetite. The patient left the hospital, but was unable to do manual labor.

In a few months, a severe secondary anemia developed, the red count dropping to 3,600,000 and the hemoglobin to 50 per cent. The white blood count

fell to 3,650. The patient was then readmitted to the hospital owing to his general condition.

May 15, 1940, he experienced a chill, the temperature rose to 105.4, and he began to cough up bright red blood. Scattered rales appeared in the left chest, with bronchovesicular breathing. Death occurred a few days later, seven months from the onset of the first symptom (pain in or about the lower right first molar tooth).

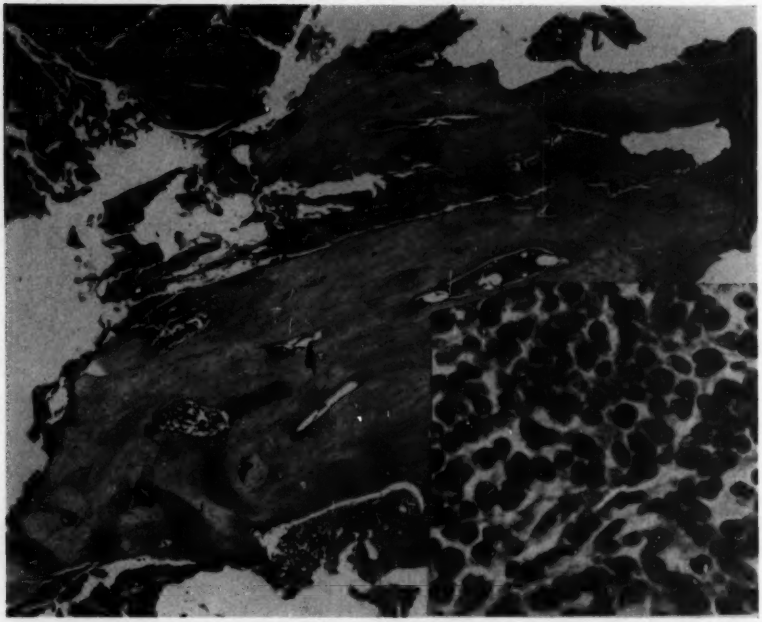

Fig. 5.—Low-power photomicrograph showing tumor invading bone trabeculae of mandible. Inset: High-power photomicrograph of same area showing highly cellular character of tumor. The reticulum cells are well outlined.

SUMMARY

In a case of primary lymphosarcoma of bone, reported because of its extreme rarity,[5] the course was that of a fulminating malignant tumor. X-ray therapy was used only as a palliative measure.

BIBLIOGRAPHY

1. EWING, JAMES: Neoplastic Diseases. Philadelphia: W. B. Saunders Co., 1941.
2. BOYD, WILLIAM: Surgical Pathology. Philadelphia: W. B. Saunders Co., 1938.
3. KAUFMANN, EDUARD: Pathology for Students and Practitioners. Philadelphia: P. Blakiston's Son and Co., 1929.
4. ASCHOFF, LUDWIG: Lectures on Pathology. New York: Paul B. Hoeber, 1924.
5. HARBITZ, W.: *Centralbl. f. Allg. Path.*, 14:759, 1903.
6. WIELAND, K.: *Centralbl. f. Allg. Path.*, 13:94, 1903.

55 East Washington Street.

ORAL PLASTIC OPERATIONS FOR RELIEF OF EXTENSIVE CICATRIZATION

J. ORTON GOODSELL, D.D.Sc., Saginaw, Mich.

FREQUENTLY, oral plastic operations of varying degrees and types are necessary before prosthesis. Many dentures that are constructed with difficulty and worn with discomfort or not worn at all because of tight muscles, scar bands, etc., could have been more easily made and more comfortably worn if adequate attention had been given to the possibilities of surgical measures prior to prosthetic efforts. Usually, the indicated surgical procedures are quite simple; rarely, they are complicated. The case report here offered is an illustration of a complicated procedure. There is no point in minutely describing each technic used since the various methods for flap retention, grafts, etc., that were employed have been reported by Kazanjian,[1] Smith[2] and others.[3] The following report demonstrates the need for utilization of various technics no one of which alone could offer the complete solution. Each individual procedure was employed as the need for it seemed to be indicated. The intervals between operations were longer than usual, but, at best, surgical measures of this kind occupy more time and call for more painstaking attention to detail than might be imagined.

REPORT OF CASE

History.—A woman, aged 50, in good health, first seen October 21, 1938, gave a history of having had "a course of calomel" when she was 5 years old which was followed by massive oral ulceration and loss of tissue. The cheeks on both sides were bound down to the crests of edentulous upper and lower ridges in the molar and bicuspid areas by broad bands of scar tissue. (Fig. 1.) The effect was one of partial cicatricial ankylosis. It was obvious that two things were necessary for the patient to have dentures at all: First, the contractures had to be freed sufficiently to allow a wider opening of the jaws, and, second, a semblance of buccal sulci, which could accept a prosthesis, had to be recreated.

Operation.—The patient was next seen on April 10, 1940, when, with local, infiltration anesthesia, the upper left side was operated on. An incision was made, slightly laterally from and parallel with the edentulous alveolar ridge from the cuspid area to the third molar area, almost down to the periosteum. The supraperiosteal tissue was dissected 1.5 cm. upward, for the distance above mentioned. This procedure involved severance of the deeply adherent scar tissue, thereby reducing the tautness of the cheek. The margin of the mucous membrane all along the lateral side of the incision was next undermined sufficiently to produce a sliding flap, which was then tucked up high in the artificially created, denuded buccal vestibule and its edge sutured to the exposed supraperiosteal tissue at its uppermost point.

This procedure brought the intact epithelial surface of the flap into medial contact with the tissue over the periosteum and developed a sulcus that

UMI

possessed a mucous membrane surface on its lateral side only. The flap also served as a means of intervention between the cut ends of the cicatrix. A modeling compound mold was used to support the flap. The method here employed consisted of forcing soft compound into the sulcus and then having the patient bite into the mass.

After trimming and adaptation to the proper shape, the material was put in place, the mandible closed against it and a Barton bandage chin support applied for immobilization. April 12, two days later, the mold was removed.

Comment.—I have satisfactorily used this simple type of flap support[3] many times when it seemed to be indicated and when other methods were impractical or too difficult. It is sufficient, in the absence of unusual tension, to hold up this kind of flap only long enough to permit it to become adherent at its base.

Second Operation.—November 7, the adherent area on the lower jaw was

Fig. 1.—Preoperative condition, scar bands left and right.

operated on, by the method described by Kazanjian[1] employing a rubber catheter as a flap-retaining device. November 10, sutures and catheter were removed.

Third Operation.—February 14, 1941, the upper right side was treated in the same manner as the upper left had been.

Fourth Operation.—The patient did not appear again for about a year. At that time, it seemed that the right side would need a skin graft and the left could be corrected by a Z plastic operation. February 17, 1942, the general surgery service furnished some split skin from the thigh and a bed was created for it in the upper right buccal area near the ridge. The skin was wrapped around a compound stent in the center of which was a small tin stent-holder with protruding perforated wings. Sutures were placed through the openings

in the tin and then carried through high on the cheek, where they were tied, holding the graft up into the bed. A light plaster Barton bandage was applied to limit mandibular and facial movement and an "elastoplastic" pressure bandage was placed externally over the area. February 27, the stent was removed and it was seen that the graft had been well taken. After this stage, the patient could open her mouth much farther than previously.

Course.—May 22, the patient came to the office with the complaint that "some stitches had not been removed." It was found that several hairs were growing in the grafted area. Evidently a portion of the transferred materials was of full-thickness rather than split and included some hair follicles. The dermatologist disposed of most of this annoyance.

After all of the foregoing procedures, it would seem that the operation should be about finished, but two areas needed surgical revision.

Fifth Operation.—October 13, the direction of two small scar bands, one on the upper right at the anterior end of the grafted area and the other at the site, previously mentioned, on the upper left, was altered. A Z plastic pro-

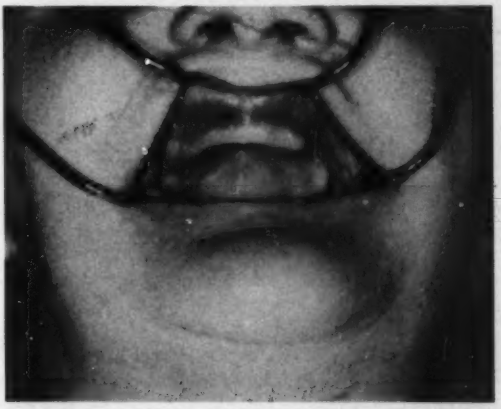

Fig. 2.—Postoperative condition, mouth ready for dentures.

cedure as described by Ferris Smith[2] was utilized for these corrections.

Outcome.—At the present time, the patient is ready, or nearly so, for the long-awaited dentures. (Fig. 2.)

BIBLIOGRAPHY

1. KAZANJIAN, V. H.: Surgical Treatment of Abnormalities of Edentulous Alveolar Processes and Palate. *Am. J. Orthodontics*, 26:263, March 1940.

2. SMITH, FERRIS: Plastic and Maxillo-Facial Surgery. Philadelphia: W. B. Saunders Co., 1942, p. 37.

3. GOODSELL, J. O.: Method of Closing Antral Openings. *D. Cosmos*, 70:1125-1197, December 1928.

502 Second National Bank Building.

Book Notices and Reviews

The editorial board acknowledges with thanks the receipt of the following volumes. A selection of these will be made for review, precedence being given to new books and those having the greatest interest for our readers.

TRAUMATIC SURGERY OF THE JAWS. Kurt H. Thoma, D.M.D. Professor of Oral Surgery and Brackett Professor of Oral Pathology, Harvard University. Cloth. 315 pages with 282 illustrations. Price $6. St. Louis: C. V. Mosby Co., 1942.

MANUAL OF STANDARD PRACTICE OF PLASTIC AND MAXILLOFACIAL SURGERY. Military Surgical Manuals, National Research Council. Cloth. 432 pages. Price $5. Philadelphia: W. B. Saunders Co., 1942.

SULFANILAMIDE AND RELATED COMPOUNDS IN GENERAL PRACTICE. Wesley W. Spink, M.D., F.A.C.P., Professor of Medicine, University of Minnesota School of Medicine. 374 pages. Price $3.00. Chicago: Year Book Publishers, 1942.

WAR MEDICINE. Edited by Winfield Scott Pugh, M.D. Commander (MC) USN Retired. Cloth. 565 pages. Illustrated. Price $7.50. Philosophical Library, New York. 1942.

This volume is an interesting and worthwhile compilation of fifty-seven articles on war surgery, aviation and Naval medicine and general medicine from a number of British and American medical and surgical journals. The thirty-three articles on war surgery include a synopsis of the subject and the surgical principles in divisional medical units. The treatment and healing of wounds in general are discussed at length and the care of war burns occurring in Naval action from fire and various chemicals is reported in detail. Included in the introductory group of papers is one on anaerobic infection of wounds. The regional consideration of war wounds includes sections on wounds of the brain, the eyes and orbit, and injuries of the eardrum and hearing apparatus. Several articles are devoted to wounds and injuries of the chest and lungs, including injuries due to the detonation of high explosives. Wounds of the heart and their operative treatment are well presented.

Shock and blood substitutes in military surgery are presented by several authors. A short but detailed article on first aid and emergency treatment of gunshot wounds of the jaws by Robert H. Ivy covers the essentials of adequate care for the various types of such injuries.

The medical considerations of aviation medicine and deep sea diving are presented in a number of articles. These include excellent treatises on the physiology of the problems. A review of cases of injury to the vertebrae occurring in the R.A.F. is included in this section. The symptoms and first aid treatment of gas casualties are presented, with an excellent chart appendix covering fifteen types of gases.

The concluding papers in this volume cover a number of important subjects, such as nutrition, diet, bacillary dysentery and painful feet, and there

are several articles on psychiatric subjects. The papers in the surgical section could have been arranged better from the standpoint of regional consideration of wounds by placing those on one specific subject together.

Much of the subject matter of this book is written by men with considerable experience in the present war. It provides instructive and interesting information and is recommended for physicians and dentists in the military service or those assigned for duty with civilian defense units.

SYNOPSIS OF TRAUMATIC INJURIES OF THE FACE AND JAWS. Douglas B. Parker, M.D., D.D.S., Associate Professor, Department of Oral Surgery, School of Dental and Oral Surgery, Columbia University. 334 pages, 229 illustrations. Price $4.50. St. Louis: C. V. Mosby Company, 1942.

This manual is presented as a concise text for members of the medical and dental professions who will be called upon to join in treating maxillofacial injuries sustained in industrial or civilian accidents or the wounds of the face and jaws resulting from war injuries: The types and general characteristics of such injuries from various sources is discussed briefly and the applied anatomy of the region is presented in an adequate and practical manner.

The emergency treatment of the patient at the scene of the accident is taken up in detail, including the measures to control hemorrhage by means of pressure control, clamping or ligation. The importance of maintenance of unobstructed respiration is stressed, and methods to prevent obstruction of the airway by the positioning of the patient, removal of blood or foreign bodies from the mouth and the throat and control of the tongue and fractured segments of the jaws in a forward position are described in detail. The diagnosis and treatment of shock is presented adequately, with emphasis on the use of blood plasma intravenously to supplement the well-known measures used to keep the patient quiet and warm and to control the pain.

A brief outline is given of the control of wound infection by accepted methods, including the use of sulfonamides both locally and by systemic administration.

Wounds of the soft tissue are classified and described and their characteristics in relation to the cause are discussed. The treatment of such wounds, particularly gunshot wounds, including suture material and the technics of suturing and details of postoperative care, is fully given.

The treatment of burns of the face is given, with emphasis on advances in the technic of burn therapy of the last few years.

The immediate and subsequent treatment of fractures of the facial bones are presented in sufficient detail to enable the reader to secure a thorough knowledge of the fundamental principles involved in the correction of displacement and the stabilization of the fractured parts. Most of the accepted methods in use today are described and adequately illustrated. The care of complicated fractures of the maxilla and mandible is thoroughly discussed and other appliances are shown.

Skeletal fixation in fractures of the mandible that cannot be successfully secured by routine methods is adequately though briefly discussed. Cases are illustrated, showing its use to control and stabilize a ramus in a case of fracture through the angle. It is also recommended for certain fractures of the edentu-

UMI

lous mandible and those of the ramus. Surgical reconstruction o. acial tissues by skin grafting and other accepted methods of plastic surgery . described. The varieties of bone grafting for defects of the mandible with operative technics are taken up. Prosthetic restoration of lost facial and intra-oral tissues and the preliminary preparation of the mouth or nose by skin grafting to replace portions of lining membranes are described.

The last six chapters are devoted to a brief consideration of anesthesia, roentgenographic technic, bandaging, feeding and diet, transportation in face and jaw casualties and the medicolegal aspect of such injuries.

This compact and comprehensive text should prove of value to dentists and physicians interested in the subject.

Current Literature

REACTION OF BONE TO METALS; LACK OF CORRELATION WITH ELECTRICAL POTENTIALS. R. T. Bothe and H. A. Davenport, Chicago, Ill.

Summary and Conclusions

Two implants of dissimilar metals were paired in such a way that varying degrees of electrical potential were obtained, and allowed to remain 6 to 11 months in femurs of cats. Bone reactions were not closely correlated with the magnitude of potential differences, but remained characteristic for a given metal or alloy. Electrolysis is not the primary cause of unfavorable bone reactions. The primary causes are determined by physical and chemical properties of the metal itself. Solubility and the degree of toxicity of the dissolution products appear to be the chief factors. If electrical potentials play no part in inciting reaction it seems safe to assume that the unfavorable reactions seen in alloys are due to the presence of toxic metals (such as nickel, copper, or manganese) in them. Alloys which consist of nontoxic metals should be nontoxic regardless of potential differences of their components. Theoretically, vitallium comes nearer to meeting this requirement than stainless steel, but tantalum may prove to be the metal of choice when sufficient data on it have been accumulated.—*Surg., Gynec. & Obst.*, 74:231, February 1942.